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Zeppelins: German Airships 1900–40



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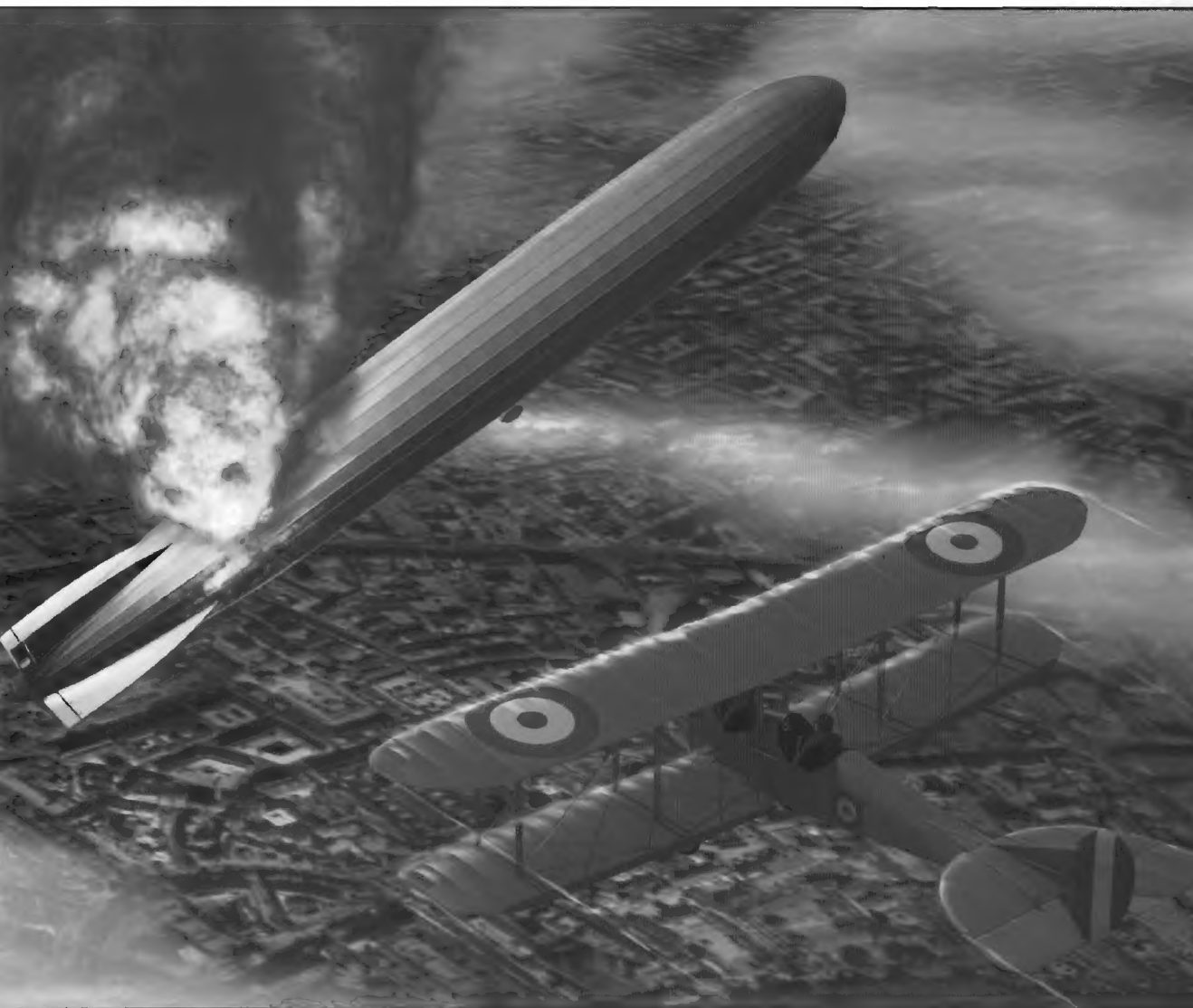


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Author's dedication

To the aeronauts who flew airships in both peace and war, and also to those who, in the latter case, opposed them.

Author's note

In writing this book I am glad to acknowledge the contribution made by several others. It is commonplace, though true, to say that without their assistance it would not have been possible for it to be written. In the UK, I owe thanks to Kevin Ryan, Mick Collins and Pamela Stephenson in particular. From Germany, I would like to thank Juergen Snyders, and from Denmark, Jørn Hertz-Nielsen, Vicepresident of the Zeppelin Museum Tønder, and his colleagues. Though they have all been of great assistance, any errors herewith are mine and mine alone.

Artist's note

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ZEPPELINS: GERMAN AIRSHIPS 1900-40

INTRODUCTION

The title of this book is, strictly speaking, something of a misnomer, for although the word 'Zeppelin' has become synonymous with the rigid airship, such nomenclature is actually incorrect. There were actually two primary manufacturers of German rigid airships, Luftschiffbau Zeppelin and Luftschiffbau Schütte-Lanz, during the period in question. Only one of these, Luftschiffbau Zeppelin, the Zeppelin Airship Company, produced airships that can strictly be termed 'Zeppelins'. When the airships entered military service, the mild confusion over their nomenclature was repeated by their service designation.

Each airship was given a manufacturer's designation upon completion: LZ, for Luftschiffbau Zeppelin, or SL for Schütte-Lanz, followed by a number. LZ 19, for example, referred to the 19th airship manufactured by the Zeppelin Company. Airships entering naval service were given the letter 'L', for *Luftschiffe*, followed by a service number, which recorded the order of commission. This meant that, for example, the 14th airship manufactured by Zeppelin, LZ 14, was designated L 1, as the first naval airship, whilst the tenth ship to enter naval service, manufacturer's designation LZ 40, became L 10.



Count Ferdinand Adolph Heinrich von Zeppelin (1838-1917) hailed from Württemberg, the state in whose army he served during the Franco-Prussian War of 1870-71. He retired in 1890 following disagreement over Prussian domination, and, aged 62, devoted himself to his vision of the dirigible airship. (Courtesy of the Zeppelin Museum, Tønder)

While this system resulted in each airship possessing two different designations, it was at least straightforward, which was not the case when it came to the Army. Initially the Army prefixed Zeppelin-manufactured airships with the letter 'Z', followed by a numeral in Roman figures, so that LZ 3, for example, on becoming the Army's first Zeppelin airship, was commissioned as Z I, while LZ 5, the second, became Z II. However, following the crash of Z II in 1910, a new airship, LZ 9, was commissioned, which entered service as the replacement, *Ersatz*, Z II. This system meant that there had been two different airships with the same Army number, while Z I was applied to three: LZ 3, LZ 15 and LZ 19.

The system was changed in 1915 when the Army airships adopted the manufacturer's prefix and number, so that LZ 34 was commissioned as LZ 34 and so on, until LZ 39, after which it was changed again. The last system consisted of adding 30 to the manufacturer's number, so that, for example, LZ 42 entered Army service as LZ 72, LZ 49 as LZ 79, LZ 51 as LZ 81 and so on. These systems and the changes to them were confined to airships manufactured by the Zeppelin Company. Schütte-Lanz vessels, originally designated as SL 1, for example, were prefixed 'SL' followed by the manufacturer's number in Roman numerals. Thus SL 5 became the Army's SL V, whereas the Navy simply adopted the existing Schütte-Lanz designation: SL 3 in naval service was designated SL 3.

These various methods of identification can be somewhat confusing, so for the purposes of this work, airships are identified primarily by their manufacturer's number, with their service number in brackets thus: LZ 82 (L 36); LZ 83 (LZ 113), etc. (See pages 39–43 for the tables listing all German rigid airships, including their manufacturer and service designations where applicable.)

This book covers the German rigid airship, the 'Zeppelin', from its inception in 1900 to the demise of the last of its kind in 1940. It does not deal with the other types of airship, either the pressure or the semi-rigid, and it is as well at this point to delineate the differences between these types.

The pressure airship is literally a dirigible (steerable) balloon, the shape of which is maintained by the gas pressure in its envelope. A gondola for the crew and engines was attached or suspended below this. Remove the gas and the envelope collapses. The semi-rigid airship was exactly the same, but with the addition of a keel on the underside of the envelope, from which the gondola (usually only one) is suspended. Again, if the gas pressure is lost then the envelope collapses. The rigid airship, however, has a structure that contains gas-cells, so that it maintains its shape irrespective of the amount of gas within those cells. Because of this, and because there were upper limits on the size of envelope that could be manufactured, rigid airships attained gigantic proportions relative to their smaller counterparts. Indeed, the sheer size of the rigid airships was their most distinctive feature. Historical writer E.S. Turner called the penultimate of the type 'a leviathan nearly as long as the *Titanic*'. He also added 'and as ill-starred', but that was only known



Peter Strasser (1876–1918) became the leader of the German Navy's airships in 1913 following his predecessor's death. An inspired leader, his faith in airships and their ability to conduct strategic attacks led to his death, when, leading from the front, he perished when his ship was shot down. (Courtesy of the Zeppelin Museum, Tønder)

in hindsight, and for several years airships appeared to form the future of aviation, as their creator had envisaged they would.

DESIGN AND DEVELOPMENT OF THE RIGID AIRSHIP 1900-14

Graf Zeppelin

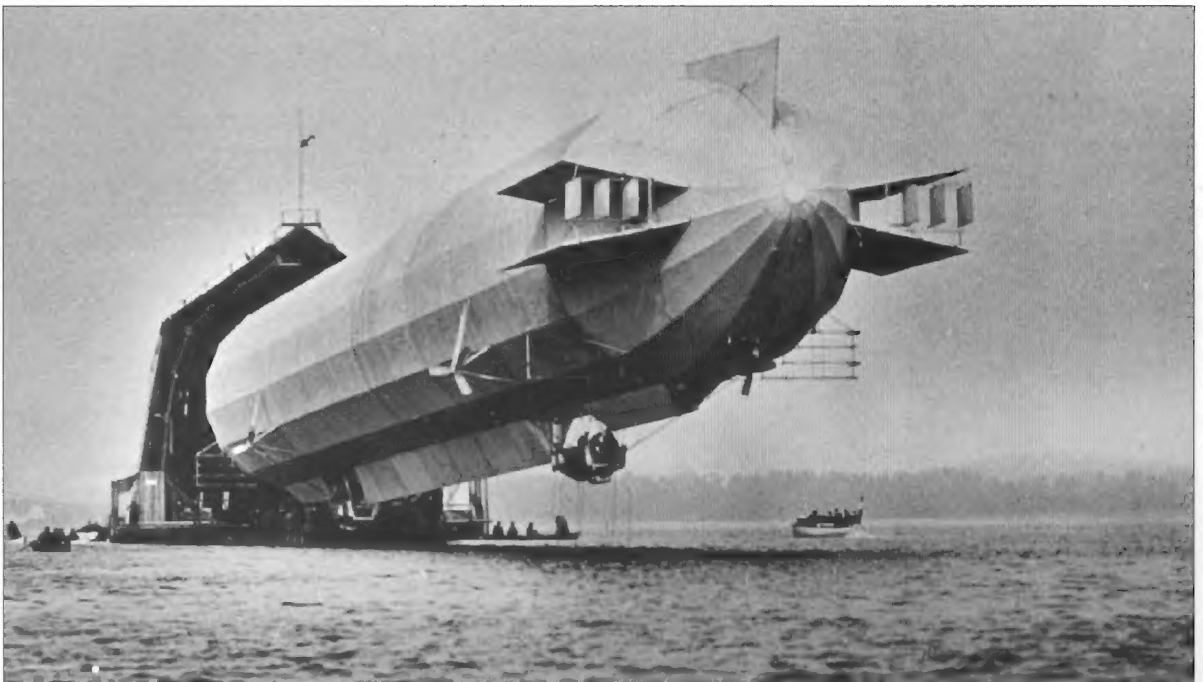
Count Zeppelin's first submission regarding the devices that were to make his name famous came in 1894, and was deemed impractical. Undeterred, he swiftly came up with a new proposal for something recognisably similar to the later machines named after him. He had become convinced that the only way he was going to see his designs realised was to raise the capital himself, which he achieved by establishing a society, Gesellschaft zur Förderung der Luftschiffahrt (Society for the Promotion of Airships). The end result was the construction, in a floating hangar on Lake Mansell, of the prototype Zeppelin, dubbed LZ, or *Luftschiff* (airship) *Zeppelin 1*.

The first airship

LZ 1 made its maiden voyage on 2 July 1900, and flew for some 18 minutes before one of the engines failed and problems developed with the rudimentary elevators. These breakdowns ended the flight and LZ 1 landed and was returned to the hangar, where further problems arose, and minor damage was caused in trying to get the huge, unwieldy, and extremely fragile, craft back into the hangar.

Lessons had been learned, and the system of trimming using the free-swinging weight was modified, by transferring the weight to a carriage that could be drawn along the exterior keel. Further flights took place on 17 and 24 October 1900, with LZ 1 reaching speeds of

LZ 3, the third Zeppelin airship is shown here, in 1906, with the floating hangar, or shed, on Lake Mansell. Note the multiple rudders and outrigger propellers, and the external keel, which were features of the early types of airship. (Courtesy of the Zeppelin Museum, Tønder)



some 32.4km/h (17.5 knots). In 1897 von Zeppelin had written that, 'It is my opinion, concerning new flying machines other than balloons, that none of the many types built to date has a future ... but I feel sure that the dependable aircraft will be developed very soon.'

He had proved that the concept of the rigid airship would work, but further development would be needed in order to make it practical. There were two main technical problems: first, the high flammability of hydrogen; second, the structural delicacy inherent in making the vessel as light as possible. It had to be light enough for its fill of gas to lift it, with something to spare for payload, and yet tough enough to endure the vagaries of the north-European weather. The very size of the craft, inherent in containing enough gas to give lift, made the drag caused by even a moderate wind significant.

LZ 2 and LZ 3

Lack of investor faith resulted in a funding crisis, however, forcing Zeppelin into liquidation in December 1900. Following a public appeal for money in 1903, an improved ship, LZ 2, was built and flew in November 1905. Its service life was brief, however, and it was destroyed on 17 January 1906. Fortunately, enough money was found to construct a third ship and this vessel, LZ 3, was to turn around the fortunes of the project, and succeeded in demonstrating the potential of the rigid airship.

LZ 3 first took to the skies on 9 October 1906, and the following year made a flight that lasted some eight hours; the naval observer on the flight submitted a positive report to his superiors, arguing that, with this vessel, 'Count Zeppelin had enjoyed a decisive success, which showed that the path he was following would lead to his goal'.

Whilst not entirely dismissing the airship for future use, the naval authorities were not interested in the version currently available. The Army, however, was more optimistic and announced that it would purchase a vessel provided it could demonstrate certain performance standards, including the ability to remain airborne for 24 hours, with a range of 700km. LZ 3 could not meet the Army criteria, and so a fourth vessel was designed.



Dr Hugo Eckener (1868–1954) joined Count von Zeppelin's company in 1906, becoming a director. He took over the leadership of the Zeppelin Company following Zeppelin's death in 1917, and is credited with saving the company. He earned international fame as the commander of the LZ 127 *Graf Zeppelin* on its global circumnavigation in 1929. Eckener opposed the Nazis and disagreed with using the Zeppelins for propaganda purposes, thus losing favour and his position. (Courtesy of the Zeppelin Museum, Tønder)



LZ 6 was designed for military use, but was never taken into service. Used for publicity purposes, with some success, the vessel burned on the ground in 1910 following an accident. This picture clearly shows the multiple forward and rear horizontal control surfaces. (Courtesy of the Zeppelin Museum, Tønder)

Emperor Wilhelm II (1859–1941), Imperial Germany's supreme warlord. Essentially a figurehead as the war progressed, he at first forbade strategic bombing, but then allowed it provided royal palaces and certain monuments, such as St Paul's Cathedral, were spared. (Courtesy of the Zeppelin Museum, Tønder)



LZ 4 and LZ 5

By this time finance was again a problem until von Zeppelin was granted permission to raise money through a lottery. The revenue generated allowed work to continue, and an improved version capable of meeting the Army's standards was constructed. LZ 4 first flew on 20 June 1908 and proved promising, undertaking several long-distance flights.

Disaster struck when, whilst moored near Stuttgart, LZ 4 was caught by the wind and broke loose from its moorings before bursting into flames. There was only one Zeppelin now left, LZ 3, and this was pressed into service in order to gain publicity, with a series of flights between 23 October and 10 November 1908. The German public became enthused by airships: 'Zeppelinitis' took hold of the national imagination as the perseverance of

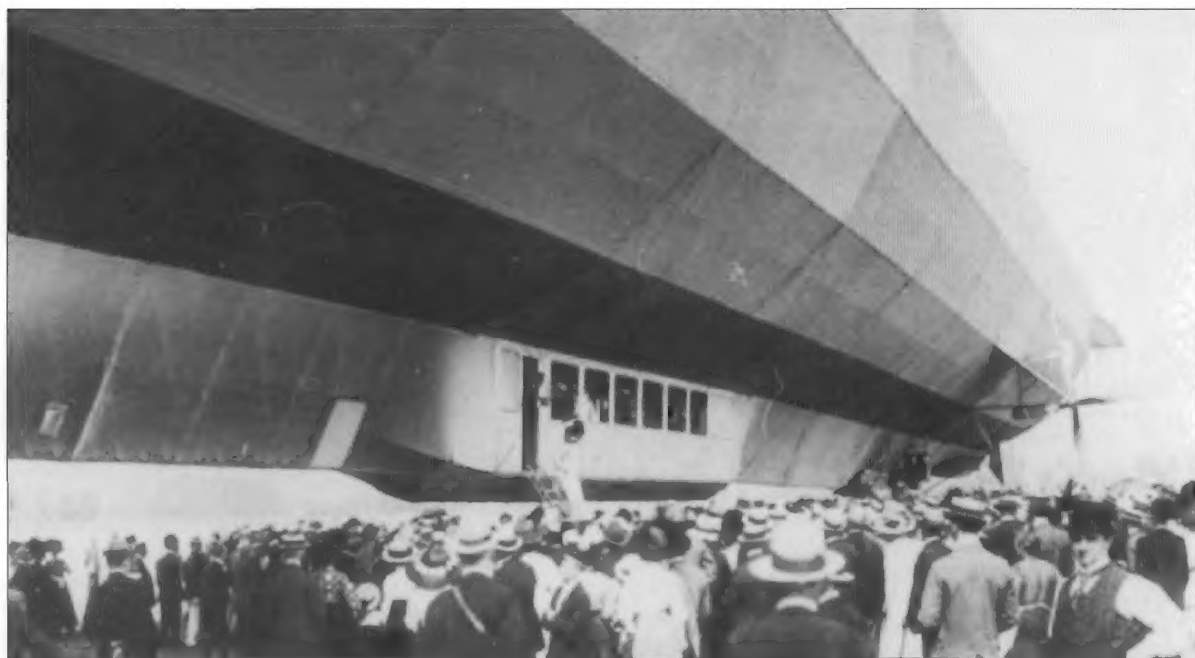
the elderly count made him something of a national hero whose magnificent machines embodied German pride and industrial skill. This was largely due to the efforts of Dr Hugo Eckener, a journalist with a Frankfurt newspaper, who had become convinced that the future of aviation belonged to the Zeppelin airship. Joining with von Zeppelin in 1906, and utilising his journalistic skills, Eckener brilliantly publicised the airship and its creator. He was largely responsible for turning the Zeppelin Company around.

A further craft, LZ 5, was built, and this vessel more than fulfilled the requirements that the military had stipulated on a journey that began on 2 June 1909 and continued for 37 hours in total. Impressed by this achievement, the Army then purchased LZ 5 and the older LZ 3, and with the proceeds from this sale, the Zeppelin Company designed and built LZ 6 with the intention of selling this to the military. Unfortunately for the count and his enterprise, the purchase fell through when the Army temporarily decided that non-rigid craft could best fulfil their requirements.

British worries

These setbacks were apparently unknown to the British Government, who saw a deadly threat in the progress of German airships. In October 1908 the Committee of Imperial Defence set up a sub-committee to consider advances in aviation as they concerned Great Britain. Upon deliberation, the committee was unimpressed by the possibilities offered by the aeroplane: 'There appears to be no necessity for the Government to continue experiments in aeroplanes.' They were, however, distinctly worried by the development of German aviation, as manifested in the inventions of Count Zeppelin. The Committee concluded that a future war would be certain to see the deployment of aircraft, and that Germany was the potential aggressor with the greatest capability in that area.

The passenger cabin of this DELAG ship, LZ 7 *Deutschland*, is clearly shown in this photograph. LZ 7 was forced to the ground by a storm and damaged beyond repair in 1910 after being in DELAG service for some four years. (Courtesy of the Zeppelin Museum, Tønder)



They dismissed the possibility of an invasion by a large-scale troop landing from airships, thus flying in the face of media-driven public opinion, which took as given that the Germans had cunning and dastardly plans for invasion. However, they did consider that a small raiding force landed from the air might inflict serious damage to a vital installation, such as an arsenal or dockyard. They concluded that the best method of countering such an attack would be to construct airships equivalent in capacity and number to those of the enemy, and recommended that funds should be allocated for this purpose.

DELAG

In an effort to demonstrate the basic soundness of his concept, von Zeppelin founded the German Airship Transportation Company, known by its German acronym, DELAG (Deutsche Luftschiffahrts AG), in November 1909. It is regarded as the first commercial airline, but bad luck struck when a succession of accidents destroyed the first three passenger ships, and once again the Zeppelin enterprise faced ruin. Nevertheless, his persistence paid off with the completion of a tenth craft on 15 July 1911. Named *Schwaben*, this airship had a successful career, eventually carrying a total of some 1,500 passengers on 218 flights, before coming to grief at Düsseldorf on 28 June 1912. Other DELAG craft included *Viktoria Luise* (LZ 11), *Sachsen* (LZ 17) and *Hansa* (LZ 13), which entered service on 30 July 1913, when the permanence of the giant vessels in Germany's skies had come to be taken for granted.

The DELAG airship *Schwaben* (LZ 10) was important in popularising the airship, particularly amongst those with enough money to indulge in aerial 'pleasure cruises'. She made over 200 such flights, conveying some 1,500 passengers safely over 27,000km, before burning on the ground in 1912. (Courtesy of the Zeppelin Museum, Tønder)

Military and naval interest

The German Army and Navy had reassessed their opinion of Zeppelin's





airships and had started to appreciate the value these craft might have for them. The renewed interest resulted in the German Army purchasing LZ 9 in 1911, (re-designated Z II *Ersatz*, after the destruction of the first Z II (LZ 5) on 25 April 1910), and the military also purchased LZ 12, which became Army airship Z III. This, the first new-build Army airship, was ordered in March 1912, flown on 25 April and delivered on 23 July.

The Navy followed suit and ordered an airship in April 1912, LZ 14, which was commissioned into service as L 1. The Navy, though, still had concerns over the performance of these craft, and argued that airships at their current stage of development were too slow for maritime use; the wind was generally stronger over the sea, so more power was required. This was clearly demonstrated on 9 September 1913, when, along with most of her crew and the head of the Naval Airship Division, Korvettenkapitän Metzing, L 1 was lost in the sea near Heligoland during a storm. Of particular portent for the future, Metzing's replacement was Korvettenkapitän Peter Strasser, who became one of the most enthusiastic advocates for the use of airships.

The Navy's second airship, LZ 18 (naval designation L 2) had an even shorter life, and her loss was a severe blow, particularly as the demise of the two naval ships constituted the first accidents to Zeppelin airships that resulted in fatalities. LZ 18 flew for the first time on 6 September 1913 and it may have been a design fault that led to her catching fire on 17 October shortly after leaving the ground. She was completely destroyed along with her entire crew and her designer.

The Schütte-Lanz Airship Company

Perhaps alarmed by the monopolist position that the Zeppelin Company had attained, particularly in technical matters, the Army started to foster the development of a rival, Luftschiffbau Schütte-Lanz. Dr Johann Schutte, Professor of Naval Architecture at the University of Danzig, had founded this firm in 1909 with the backing of a group of industrialists, and the design they had come up with featured a novel departure from the Zeppelin concept. Instead of a hull formed from aluminium girders, Schütte-Lanz manufactured theirs from laminated plywood, which, it was believed, would be lighter and more resilient.

Commissioned as Z I, LZ 3 was the first Army airship, but was scrapped as obsolete in 1913. (Courtesy of the Zeppelin Museum, Tønder)

AIRSHIPS IN THE GREAT WAR

1914-18

Heeresluftschiffe - the Army airships

In August 1914, seven airships were available to the Army; four were deployed in the West and three in the East. Three of those assigned to the West attempted to bomb French military targets in daylight; they were all destroyed and it was immediately obvious that airships could not carry out any role during daylight. The three airships in the East completed their first mission on 28 August 1914 – a bombing raid against the railway station at Mława. However, enemy action forced one down and the crew were taken prisoner. The Army airships were also in action in the south during the Romanian Campaign of autumn 1916, when they conducted several strategic raids against Bucharest and the Ploesti area.

On the night of 31 January–1 February 1916, LZ 55 (LZ 85) raided the harbour at Salonika with 6,000kg of bombs, and the combat log demonstrates the surprise that could be effected with an attack from the air. It also gives an idea of the endurance that was required to conduct an operation of this nature on a sortie that lasted some 18 hours.

The crew sighted Salonika, but south of the town, still over the sea, was a dense bank of clouds. The ship stopped south of Salonika in order to observe the harbour and the ships at the quays, and some darkened steamers and ships with lights set were discovered in the



The first of the Schütte-Lanz airships, SL 1 was unique in its construction in having a geodetic frame, which can clearly be seen in this photograph. Subsequent construction reverted to the same type of framework as Zeppelin models, though they were still manufactured from plywood. (Courtesy of the Zeppelin Museum, Tønder)



The replacement for LZ 3, LZ 15 was given the same Army number Z 1. Note the four-bladed propellers towards the stern, as against the two-bladed variety at the bow, and the evolution of the rear control surfaces from earlier models. (Courtesy of the Zeppelin Museum, Tønder)

bay. LZ 85 headed for two probable transport vessels and then to the harbour moles with their ammunition storage facilities. Some 60kg bombs were aimed at the ships and there was one hit close to the starboard side of one large vessel. It was impossible to say if any of the unlit ships were damaged in the attack. Most of the GP [general-purpose] bombs were released over the harbour and railway installations. Two of them detonated at the head of a mole and a further six in the inner harbour, and others hit the stores, causing huge explosions and possibly setting ammunition ablaze. The last bomb was responsible for a fast-spreading fire. Altogether fourteen small bombs were dropped on military warehouses northwest of the town. Only a very few guns managed to engage the airship because its appearance came as a surprise to the enemy forces. After that the ship left the Salonika area and returned the same way it had come ...

On a return visit later that year, however, LZ 55 (LZ 85) was downed by ground fire, and the Army began to withdraw the craft from the theatre after that, with the last one, LZ 71 (LZ 101), leaving in September 1917.

Some sorties were flown against the French towns of Nancy and Poperinghe in April 1915, but a change in the nature of the air war came during May when the first of the new improved ships, LZ 38, reached operational status. Following a change in government policy, and in line with the strategic vision of Peter Strasser, the head of the naval airships,



This scene was widely reproduced and distributed on various postcards and the like in Allied countries. It shows the remains of LZ 55 (LZ 85), the airship which had been downed by ground fire at Salonika in 1916. (Courtesy of the Zeppelin Museum, Tønder)

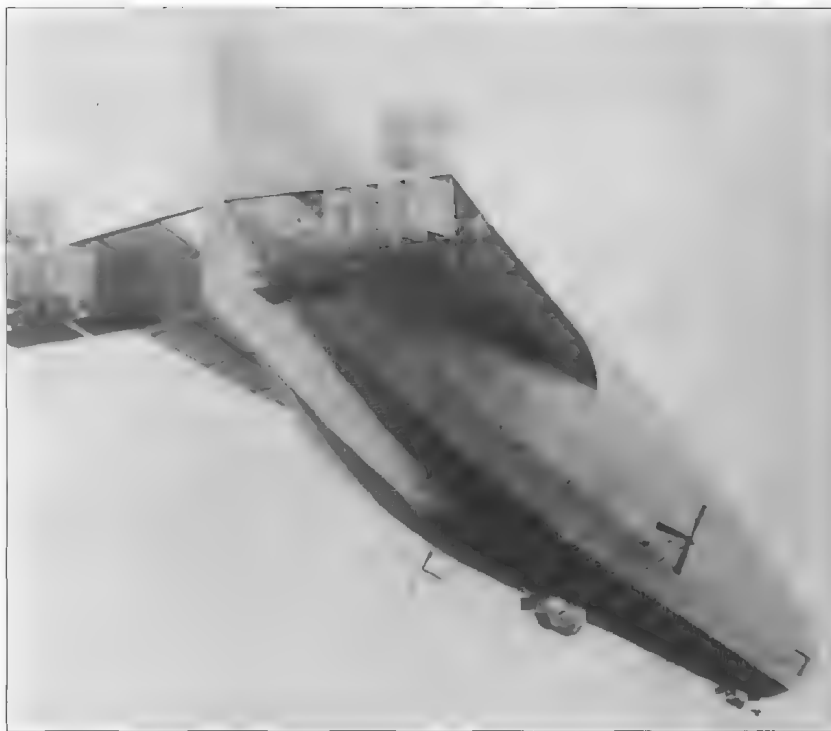
the Army vessels joined their maritime counterparts in a strategic campaign. This operation and others like it carried out in 1915 were the first examples of strategic bombing in the 20th century. However, the Army had not completely abandoned the idea of using airships in a tactical role, as shown during the fighting for Verdun. Four ships were sent to support the ground attack on 21 February 1916, although only two survived.

Airships of the *Reichskriegsmarine* – naval airships

It had been envisaged that the role of the North Sea coastal bases and their complement of airships would centre on reconnaissance, and indeed throughout the course of the Great War some 220 such missions were carried out. However, given the refusal of the High Sea Fleet to involve itself with fleet actions against the much superior British Grand Fleet (apart from the engagement at Jutland in 1916), these missions were not always of primary tactical or strategic importance, despite the usefulness of the data gathered. The improved vessels that came into service in 1915, the 'm2' and 'p' types, did, however, allow a different strategy to be contemplated: the strategic bombing of Britain.

The strategic campaign

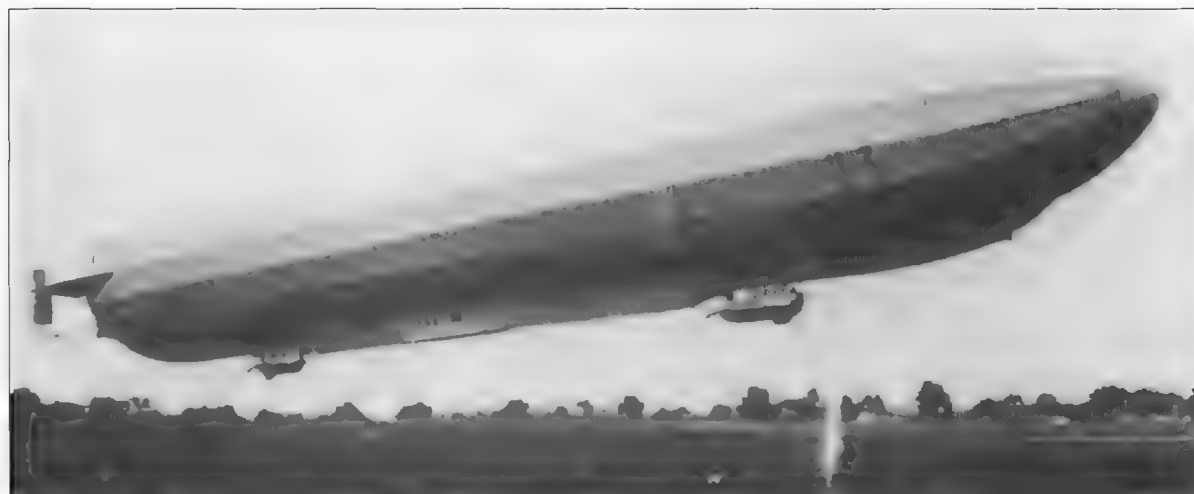
The night of 19–20 January 1915 ushered in a feature of 20th-century warfare that was to become all too familiar: strategic air attack. The distinction between tactical and strategic warfare is sometimes indistinct

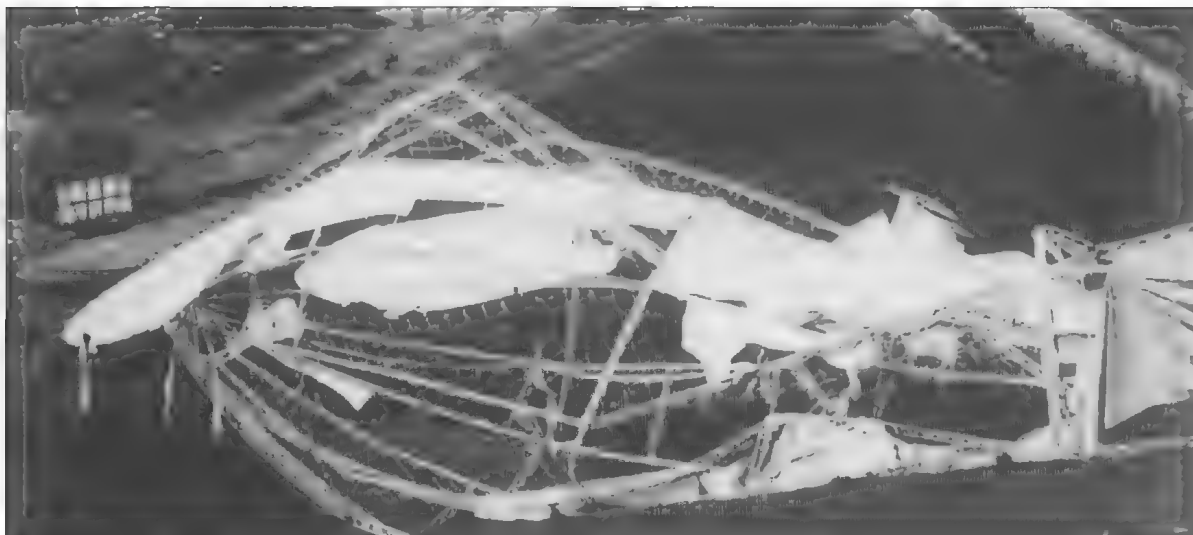


The second airship to enter naval service, LZ 18 (L 2), had an extremely short service life, exploding only eight days after first taking to the air in 1913. This loss, combined with that of L 1 earlier the same year, meant that, up to that time, the Navy's experience of rigid airships had been somewhat unfortunate. (Courtesy of the Zeppelin Museum, Tønder)

– essentially it lies in the purpose of the attack. Tactical attacks are made with the intention of defeating military or naval forces, whereas strategic attacks aim to defeat states without fighting their military or naval forces. Those advocating or waging strategic warfare thus eschew Clausewitz's maxim that advocates the necessity of defeating an enemy's armed forces before victory can be achieved. This philosophy was grounded in 18th-century experience – prior to the introduction of aerial warfare, an enemy's armed forces usually stood in the way of waging war on infrastructure and population. By 1914, enemy forces could, for the first time, be bypassed without the need to defeat them or fix them in position, and a state's civil population and infrastructure could be

Following the losses of LZ 14 (L 1) and LZ 18 (L 2) in 1913, LZ 24 (L 3) was the only Navy airship in commission at the start of the Great War. She took part in the first strategic raid on Britain, dropping her payload on Great Yarmouth on the night of 19–20 January 1915. (Courtesy of the Zeppelin Museum, Tønder)





LZ 5 had gone some way towards demonstrating the potential of the rigid airship by completing a 37-hr flight in 1909. She was wrecked by a storm the following year, demonstrating the inherent fragility of the type. (Courtesy of the Zeppelin Museum, Tønder)

directly attacked. Another line of engagement or 'front' – the 'Home Front' as it later became known – had been introduced to warfare.

The first strategic air offensive in history began somewhat inauspiciously on the night of 19–20 January 1915: two naval airships, LZ 24 (L 3) and LZ 27 (L 4), bypassed the battlefields of northern France, and crossed into Britain over Norfolk. They proceeded to drop bombs on areas that were lit up, presuming, correctly, that they represented centres of population. L 3 hit Great Yarmouth and L 4 a number of East Anglian villages. Their tally for the night was four dead and 16 injured.

Further attacks over the following months were mainly, though not exclusively, aimed against targets in southern England, particularly London. The first London raid occurred on the night of 31 May–1 June, with seven people being killed and over 30 injured. These attacks, and similar ones against France, such as that on 31 January 1916, when LZ 47 (LZ 77) attacked Paris with 2,000kg of ordnance, were against largely undefended targets. Having given notice of their intentions, though, this state of affairs could not be expected to continue, and the short period of darkness during summer time meant that the airship's greatest asset, its invisibility, could be compromised. Accordingly, operations were largely suspended during the summer of 1915, with the plan being to resume them, with greater weight and effectiveness given the improved machines in the pipeline, during autumn of that year.

Retaliation

That the British would take retaliatory measures became evident in April 1915 when Captain Lanoe G. Hawker, of the Royal Flying Corps based at Abeele in Belgium, flying a B.E.2c armed with a few bombs and hand grenades, attacked and destroyed the airship shed at Gontrode, within which, and also destroyed, was LZ38 (LZ38). It was an audacious attack, and highlighted just how vulnerable the airships were when on the ground.

That they might be as vulnerable, given certain conditions, whilst airborne was graphically demonstrated on 6–7 June 1915, when Lt. R.A.J. Warneford of the RNAS was flying toward Ostend on his first ever night

flight. His mission, emulating the earlier effort against Gontrode, was to bomb the Zeppelin sheds at Evere. Whilst en route he spotted LZ37 (LZ37) in the clouds. Warneford manoeuvred his plane over the vessel and released his bombs, one or more of which hit something solid. In any event there was a great explosion that ignited the gas, and the LZ37 (LZ 37) fell earthwards engulfed in flames. This was the first time an airship had been destroyed by an aircraft whilst in flight.

Target London

Strategic attacks in greater strength were resumed in September 1915, and below are extracts from the combat report of LZ 44 (LZ 74), which raided London on the night of 7–8 September 1915. During the raid more than 4,800kg of bombs hit London, Middlesbrough and Norwich, making it the heaviest raid directed against Britain during the whole of the First World War.

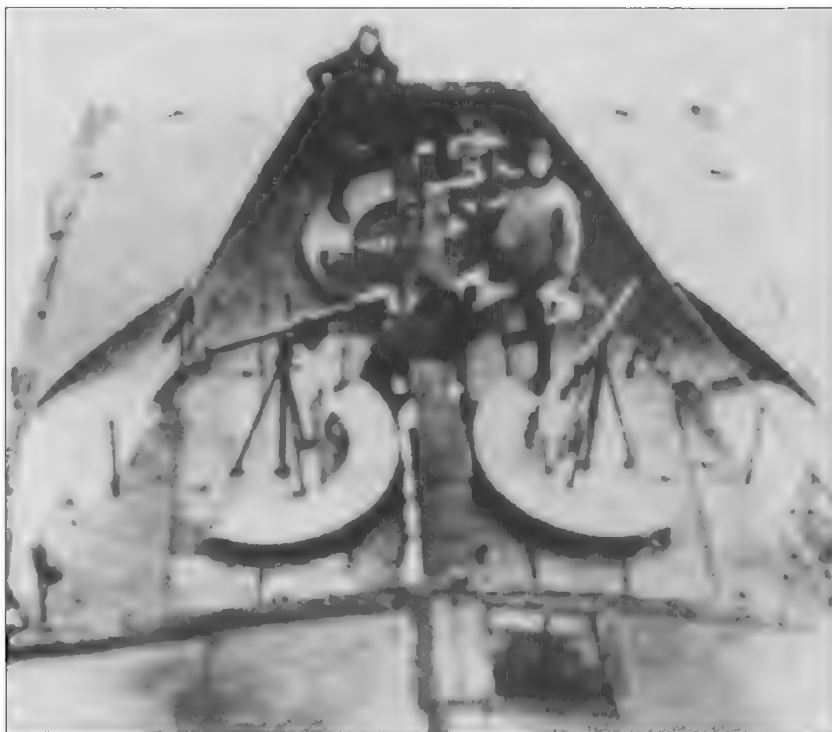
Departure 19.27 in the evening ... LZ 74 crossed the British coast north of the Thames near Foulness Island. Only a few lights were visible on the ground and only a pale glow in the direction of the city of London when approaching at an altitude of about 3,200m. All the suburbs over which the airship passed were completely blacked out. Following the direction of the wind, and bearing in mind the known positions of British defences, the order was to attack London from the north when LZ 74 reached Brentwood-Woodford. Meanwhile the first searchlights were noticed ...

The account relates how, later, the commander of another airship on the sortie, SL II, mentioned that when that ship reached London, some ten minutes before LZ 74, only a few searchlights were in action. The staggered arrival of the aircraft had allowed the defences time to mobilise. The log of LZ 24 (L 3), which was also on the raid, confirms this:

Navigation from Kings Lynn to London was straightforward because the landscape was completely dark and most of the cities were still lit up. London was still very brightly illuminated ... Orientation over the entire capital was very easy because Regent's Park



RIGHT LZ 47 (LZ 77)'s defensive machine-gun position. Airships that saw wartime service were equipped with various defensive armament, until the advent of the 's type' – the 'Height Climbers'. This machine-gun position, mounted on top of the hull forward, was intended to provide fire against attacking aeroplanes. (Courtesy of the Zeppelin Museum, Tønder)



was located precisely and the city centre was lit up as if in peace-time ... the crew began dropping bombs near High Holborn at an altitude of about 2,500m.

LZ 74's account continues:

It was impossible to avoid contact with the searchlights ... however, it was very dusty over London and thus the beams did not have a very great range. Although more than ten large lights were trying to pinpoint the ... airship it was only possible to hit [sic] LZ 74 for a few seconds. The ... crew recognised the River Thames with its bridges and ships. All the railway stations were well camouflaged.

Despite being camouflaged, the railway stations could be identified by the tracks leading to them, which are extremely difficult to conceal. One of these, identified as 'Leyton railway station', formed the first target, though it was only bombed to reduce the airship's flying weight before moving on to the docks, the 'main targets'. There, it was estimated, bombs fell on the Surrey Commercial, and, possibly, the West India Docks, as well as Bethnal Green Station. The apparent damage done and the response provoked were also recorded:

Large fires were visible from the sky. Between 12.54 and 01.50 the airship was engaged by several batteries, but without any success. One of many incendiary shells, recognisable by their white smoke trails, passed by LZ 74 within a few metres before exploding about 400m above the ship. Both gunners, standing on top of the hull of the Zeppelin, took cover because some of the shells were so close.

LEFT The memorial to Lt. R.A.J. Warneford of the RNAS in Brompton Cemetery, London. On his first night flight, on 6–7 June 1915, Warneford spotted LZ 37 and eventually manoeuvred his plane over the vessel and released his bombs. One or more of them caused a great explosion and the airship fell earthwards, engulfed in flames. This was the first time an airship had been destroyed by an aircraft whilst in flight. Warneford was killed shortly afterwards in an accident. (Author's collection)



Having dropped its bomb-load LZ 74 then headed back, leaving England 'near the River Crouch' and utilising cloud cover to shield it from ground fire. The report admits that 'there was no possibility of the commander and his men determining the actual position of the ship', which is evidence of the somewhat primitive state of aerial navigation at that time. Nevertheless, the crew got their bearings after crossing the Channel and 'landed at Namur at about 10.10', with the only damage being 'two hits' on the structure and one engine which failed through 'mechanical defect'.

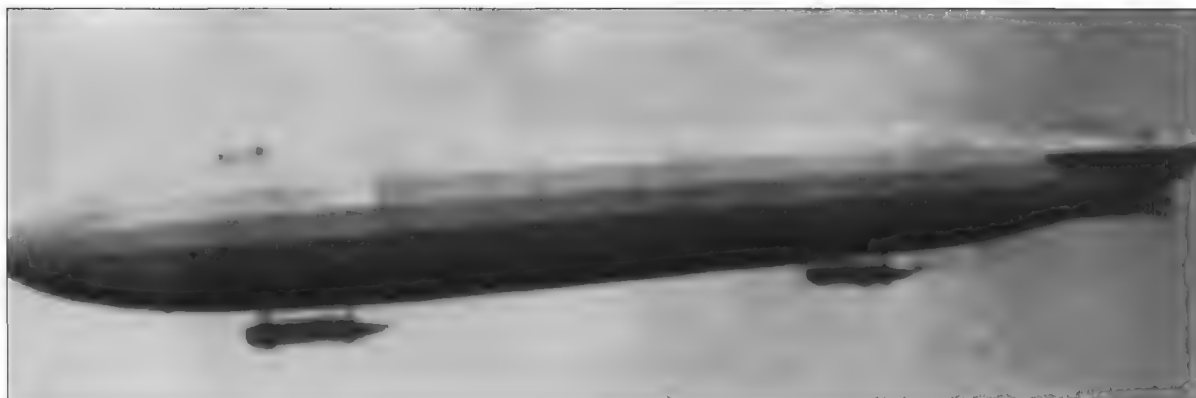
During 1915 some 30 strategic missions were flown, dropping a total of around 37,000kg of bombs. However, this did not result in a slackening of British morale or a diminution of industrial capacity.

1916

The year 1916 saw a greater effort to 'force England to her knees' via war from the air. This was especially so when the first of the 'r' class airships, colloquially known to the British as 'Super Zeppelins', took to the skies with the commissioning of LZ 62 (L 30) and her induction into active service at the end of May. Sixteen of these vessels were to be completed before the end of the war, and they were to form an important part of the strategic offensive, though with decreasing chances of success as the British began to counter the attacks.

Utilised on the Eastern Front, LZ 56 (LZ 86) a 'p' type airship, is seen at low level showing a good view of the machine-gun position forward, and a crew member. This helps put the size of the machine into perspective. The ship crashed and was lost in September 1916. (Courtesy of the Zeppelin Museum, Tønder)

LZ 43 (L 12) is probably unique in that, after it had landed in the North Sea after being shot down by artillery fire on the night of 9-10 August 1915, it was towed into Ostend by a torpedo boat. Though too badly damaged to be repaired in situ, most of the vessel was salvaged in parts. (Courtesy of the Zeppelin Museum, Tønder)



This leaflet, distributed along with *The Daily News*, carried a warning from Sir Edward Henry, the Commissioner of the Metropolitan Police, as to what steps to take in the event of an air raid over London. Dated 26 June 1915, it states: 'All windows and doors on the lower floor should be closed to prevent the admission of noxious gases. An indication that poison gas is being used will be that a peculiar and irritating smell may be noticed following on the dropping of the bomb.'
(Author's collection)

POLICE WARNING.

WHAT TO DO WHEN THE ZEPPELINS COME.

Sir Edward Henry, the Commissioner of the Metropolitan Police, has issued a series of valuable instructions and suggestions as to the action that should be taken by the ordinary household or resident in the event of an air raid over London.

New Scotland Yard, S.W.
June 26, 1915

In all probability if an air raid is made it will take place at a time when most people are in bed. The only intimation the public are likely to get will be the reports of the anti-aircraft guns or the noise of falling bombs.

The public are advised not to go into the street, where they might be struck by falling missiles; moreover, the streets being required for the passage of fire engines, etc., should not be obstructed by pedestrians.

In many houses there are no facilities for procuring water on the upper floors. It is suggested, therefore, that a supply of water and sand might be kept there, so that any fire breaking out on a small scale can at once be dealt with. Everyone

should know the position of the fire alarm post nearest to his house.

All windows and doors on the lower floor should be closed to prevent the admission of noxious gases. An indication that poison gas is being used will be that a peculiar and irritating smell may be noticed following on the dropping of the bomb.

Gas should not be turned off at the meter at night, as this practice involves a risk of subsequent fire and of explosion from burners left on when the meter was shut off. This risk outweighs any advantage that might accrue from the gas being shut off at the time of a night raid by aircraft.

Persons purchasing portable chemical fire extinguishers should require a written guarantee that they comply with the specifications of the Board of Trade, Office of Works, Metropolitan Police, or some approved Fire Prevention Committee.

No bomb of any description should be handled unless it has shown itself to be of incendiary type. In this case it may be possible to remove it without undue risk. In all other cases a bomb should be left alone, and the police informed.

E. R. HENRY.

EXTRACT FROM LATEST POLICE WARNING:

KEEP SAND AND WATER HANDY.

Press Bureau.

In view of the possibility of further attacks by hostile aircraft, the Commissioner of Police deems it advisable to call attention to the public warning published on June 26 recommending residents to

remain under cover, and advising them for dealing with incendiary fires to keep a supply of water and sand readily available.

(Signed) E. R. HENRY,
Commissioner of Police of the
Metropolis.

The development of aeroplanes technologically advanced enough to reach the altitude at which the airships operated was not in itself enough to render the Zeppelins vulnerable; the aeroplanes also had to be equipped with ordnance that could exploit the flammable properties of the hydrogen gas. Each drum or belt of machine-gun ammunition carried a combination of ordnance: explosive rounds were combined with incendiary bullets. The explosive bullets would create holes in the hull and gas cells, whilst the incendiary rounds would ignite the escaping gas. This was successful and was graphically demonstrated by the spectacular destruction of SL 11 (see Plate F), which was bad enough, but worse was to follow when the 'Super Zeppelins' LZ 72 (L 31), LZ 74 (L 32) and LZ 78 (L 34) were despatched by similar methods through September–November 1916.

After LZ 76 (L 33) was lost to anti-aircraft artillery (AAA) fire in September, the German high command realised that airships might not

be capable of functioning in their allotted roles without improvement in performance. Indeed, many years later in 1934, Field Marshal Paul von Hindenburg revealed that von Zeppelin himself had confided to him in 1916 that, in his opinion, the airship was obsolescent and the future belonged to aeroplanes.

At the close of 1916 then, six airships had been lost during raids over Britain due to enemy action, and the Army was separately arriving at the same conclusion as von Zeppelin. Despite this, raids continued throughout the winter of 1916–17, and Strasser remained convinced that it was a worthwhile endeavour. He also attempted to find ways of improving the viability of the airships for waging this campaign.

1917

The only feasible improvement that could be made to airships in order for them to avoid destruction by fighter aeroplanes was to increase their operational altitude. As Strasser put it, 'High altitude is the best defence against aeroplanes, and a greatly increased attack altitude is so necessary for further airship operations against England that all resulting disadvantages, including a reduction in speed, must be accepted.'

The reduction in speed came about because altitude in a given size



of airship can only be traded off against weight, and it was decided to remove one engine from both LZ 80 (L 35) and LZ 86 (L 39), thus immediately saving some 1,750kg. In early February these vessels attained altitudes of over 5,000m. The first of the type to be manufactured, rather than extemporised, was LZ 91 (L 42), which was flight-tested on 28 February, achieving an altitude of some 6,000m. Known, for obvious reasons, as 'Height Climbers' by the British, and designated 's' type by their opponents, these vessels formed the strategic striking force envisaged by Strasser until the last year of the war; the 'r' type were retrospectively modified to give them similar attributes.

Despite the fact that the 'Height Climbers' could operate outside the range of aircraft and AAA fire, they were not a great success, simply because of the hitherto unknown difficulties of operating at such altitudes. Neither humans nor machinery function properly in such cold, low-oxygen, environments, and the problems of predicting the weather so far above ground, together with the increased fragility of the lighter frameworks, made the high winds found in the sub-stratosphere dangerous. Navigation also became even more problematic than before.

The first raid on England utilising high altitude airships, LZ 79 (L 41), LZ 80 (L 35), LZ 86 (L 39), LZ 88 (L 40) and LZ 91 (L 42), took place on the night of 16–17 March 1917. It was not a great success, and one ship was lost, mainly because of the effects of the weather. After ineffectually dropping six bombs on Kent, L 39 was driven off course by strong winds and then suffered apparent engine failure. The airship drifted over

The prototype 'Super Zeppelin', LZ 62, was the first six-engined 56,000m³ airship, and the first to exceed 100km/h in speed. She was the forerunner of the 'r' type of 17 vessels. She survived the war and was handed to Belgium as part of war reparations. (Courtesy of the Zeppelin Museum, Tønder)



One of the 'r' type airships, the 'Super Zeppelins', LZ 72 (L 31) first took to the skies at the end of May 1916. 17 of these vessels were to be completed before the end of the war, but they were found to be increasingly vulnerable to aeroplane fighters. (Courtesy of the Zeppelin Museum, Tønder)



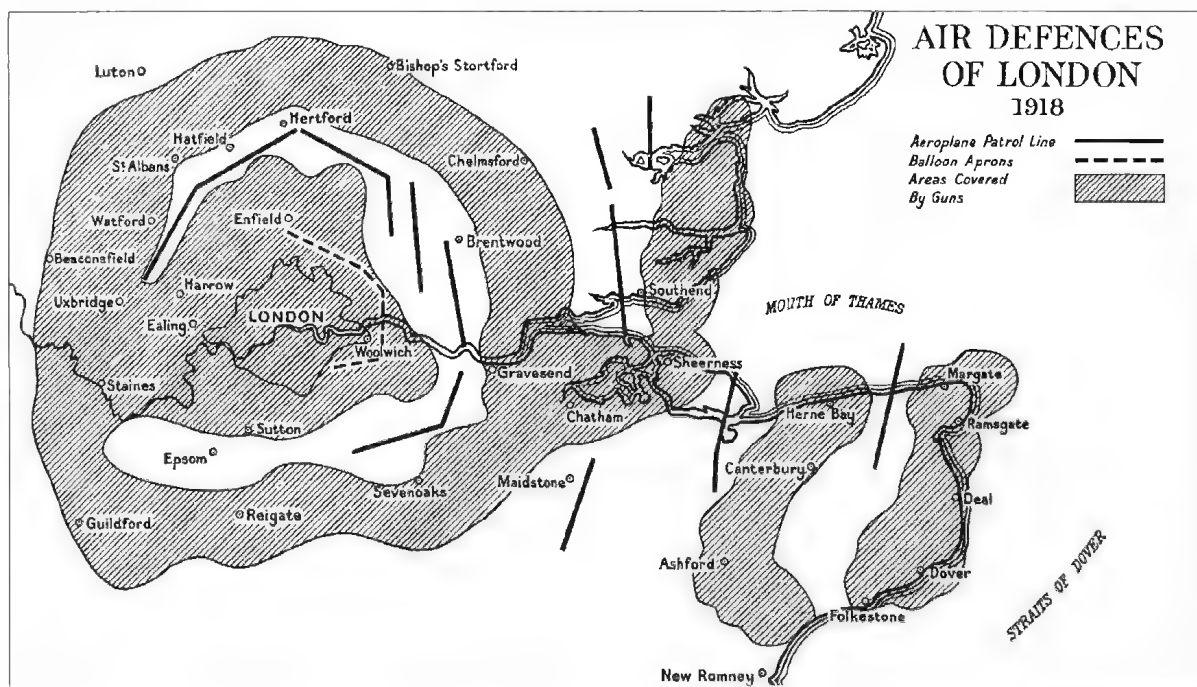
LZ 92 (L 43) was the second ship of the type 's' 'Height Climbers', constructed in an attempt to get above the maximum ceiling of fighter aeroplanes. Ironically, this airship was destroyed by an aeroplane within three months of commissioning in 1917. (Courtesy of the Zeppelin Museum, Tønder)

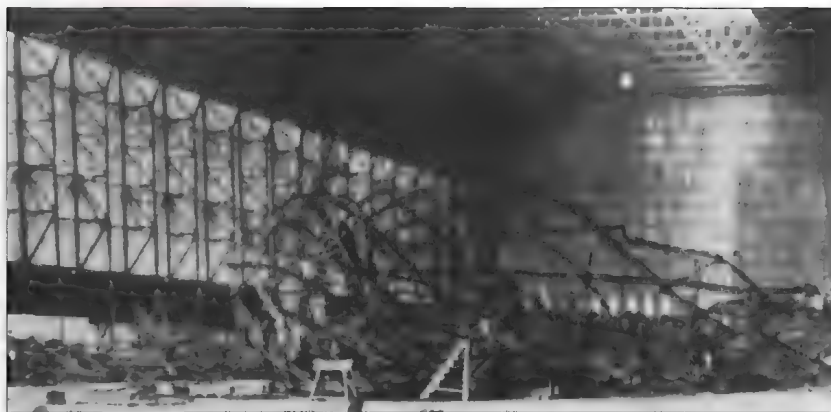
BELOW London was probably the first city to have an integrated air defence system. This 1917 map shows the various components of the system and how they interacted with each other. By this time, bomber aeroplanes were also making their mark. (Courtesy of Mick Collins)

France at reduced altitude and was hit by AAA, which caused it to crash in flames near Compiègne. Despite the fact that the bombs dropped on southern England had caused almost no damage, the airships' altitude gave them a certain invulnerability that concerned the British, whose defences appeared to have been 'vertically outflanked'.

Further raids using altitude for protection took place on 23–24 May and 16–17 June, the latter raid causing severe damage as bombs hit (quite by chance) a munitions store at Ramsgate. On this occasion, however, LZ 95 (L 48), one of the newer 'u' type vessels, got lost after dropping bombs in open countryside and reducing altitude from about 5,500m to 4,000m, an altitude where aeroplanes could operate. A British fighter climbed to within 150m and discharged a drum of anti-airship ammunition into the lower stern of L 48 and the ship fell burning to the ground, though incredibly three crewmembers survived.

Despite this loss, the raids continued, with attacks carried out on the night of 21–22 August and 24–25 September by eight and nine airships respectively. Neither of these produced any great results, with most of the





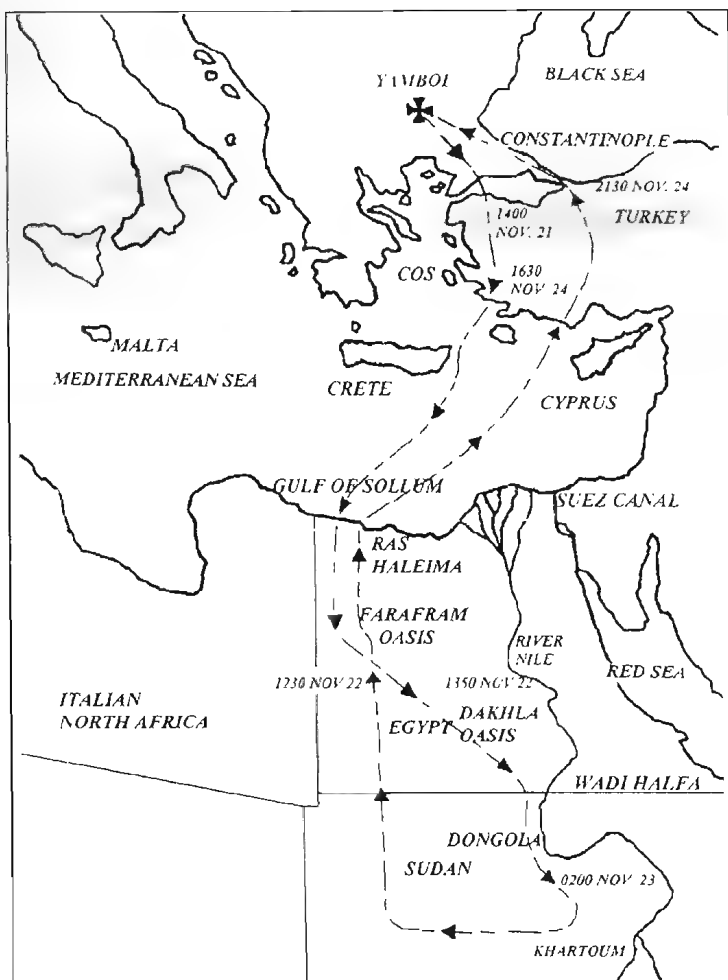
bombs falling in open countryside. The intensity of the raids was stepped up with an 11-ship raid on the night of 19–20 October, but this was to end in disaster with the loss of five vessels, LZ 93 (L 44), LZ 85 (L 45), LZ 96 (L 49), LZ 89 (L 50) and LZ 101 (L 55), through the action of the weather at extreme altitudes. It seemed that in overcoming their first major technical difficulty, the flammability of hydrogen and the British ability to exploit it, the airships had fallen foul of the second, their inability to function against high winds because of the fragility of their design. This second problem was partially overcome by the introduction of engines that could maintain a decent output at altitude, though even these in LZ 105 (L 58) did not prevent the vessel having to abort a mission to bomb Britain on 12–13 December because of high winds.

African interlude – the flight of the *Afrikaschiff*

Another endeavour to ‘vertically outflank’ the forces blockading Germany and her allies involved the attempt to relieve the force engaged in the colony of German East Africa – now Tanzania. Under the inspired command of General von Lettow-Vorbeck, German forces had successfully resisted attempts to capture them since the outbreak of war. Relief in the proper sense of the word could not be realistically contemplated, but an airship could perhaps deliver some much-needed supplies, and success in the venture would be a morale-boosting propaganda coup.

A vessel capable of making the flight from Yambol in south-eastern Bulgaria, the southernmost airship base in territory held by the Central Powers and about 100km from the Black Sea coast, to East Africa was constructed by inserting two extra gas cells in LZ 102 (L 57), was under construction. This was done prior to seeking approval for the mission, which was granted by the Kaiser on 4 October. The Lettow-Vorbeck force was informed by radio that the airship would arrive some time after the middle of the month. Aside from the extra length, which made the *Afrikaschiff*, as it came to be known, the largest airship ever constructed at the time, there were several other unique features. As it was to be a one-way journey, the entire airship was intended to be consumed by the East African forces; the hull covering was made of cotton, which would provide fabric for new uniforms, whilst the gas cells could also be re-worked. The metal structure would be used for building material and the engines for electricity generators. The cargo consisted of machine guns and ammunition, medical supplies, as well as sewing machines and radio spares.

The Allied inability to tackle the ‘Height-Climbers’ led to renewed efforts to destroy them at their bases. With the conversion of HMS *Furious* into an aircraft carrier, British aeroplanes were within range of Tønder (now in Denmark), one of the biggest Zeppelin bases. It housed three hangars, the largest able to accommodate two airships at once. On 19 July 1918, *Furious*, with a half squadron of battleships in support, was off the Danish coast, and launched seven Sopwith Camels in two flights some 20 minutes apart. This, the first carrier strike in history against a land-based target, was judged a great success. The large hangar, the ‘Toska’ shed, was bombed, destroying its contents – LZ 99 (L 54, shown here) and LZ 108 (L 60). (Courtesy of the Zeppelin Museum, Tønder)



Between 21 and 25 November 1917 the *Afrikaschiff* completed a continuous flight of 95 hours, over some 6,800km through greater extremes of climate than had ever been traversed by an airship before. (Courtesy of Mick Collins)

The loading and fitting out had been completed by 7 October, but on that day disaster struck: the *Afrikaschiff* was destroyed by a storm while attempting a test flight. With remarkable speed another airship, LZ 104 (L 59) was converted for the role and fitted with replacement materiel. After two abortive attempts, the relief mission finally took off on 21 November, at more or less the same time as reports reached Germany that Lettow Vorbeck had finally been beaten: the flight was too late! Attempts at recall failed, however, and so the *Afrikaschiff* continued on its long and unique voyage, reaching the latitude of Khartoum in the Sudan by the morning of 23 November before a radio message was finally received, whereupon the airship turned round and returned to Yambol. Despite the ostensible failure, the mission had been an epic achievement, for when the airship arrived back at her start point on the morning of 25 November, she had completed a continuous flight of 95 hours, and traversed some 6,800km through greater extremes of climate than had ever been managed by an airship before.

The *Afrikaschiff* was retained at Yambol for use as a long-range bomber, raiding various points in the Mediterranean. In this role she was not a great success, and burned in flight on 7 April 1918, whilst attempting to attack the Grand Harbour at Malta. The cause of the fire is unknown, but the legacy of the *Afrikaschiff* was important. It proved that airships were capable of long-range intercontinental flights, and this legacy was explored further in the post-war period.

1918

The first strategic raid of 1918 on Britain was on 12–13 March, using five of the latest airships: LZ 99 (L 54), LZ 100 (L 53), LZ 106 (L 61), LZ 107 (L 62) and LZ 110 (L 63). The raid was rendered ineffective by the weather – not winds on this occasion, but rather thick cloud that obscured the ground. Another five-ship raid on 12–13 April was notable for the airship gunners hitting an aeroplane that was attempting to close with their ship, LZ 107 (L 62), and forcing it to break off and land. This successful instance of defensive gunfire is believed to have been unique, but an experiment that might have afforded a greater defensive capability had taken place on 26 January. The airship LZ 80 (L 35) took off with an Albatross D-III fighter suspended beneath it, which was



This photograph shows LZ 86 (L 39) with the hangars at the airship base at Ahlhorn, Oldenburg, in the background. Some idea of the scale of these structures can be obtained. (Courtesy of the Zeppelin Museum, Tønder)

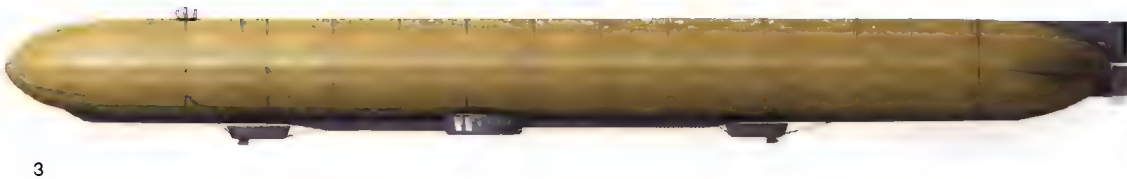
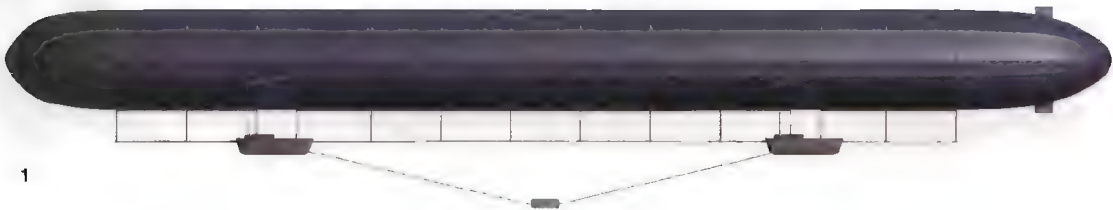
successfully dropped from a height of some 1,200m, and flew safely away. The rationale behind this experiment is clear enough, but the project was not explored further.

The airship as a combat weapon was becoming obsolescent, though the tireless advocate of both the weapon and its strategic use, Peter Strasser, continued to deny this, and on 5–6 August himself led a five-ship raid to bomb London. Strasser's 'flagship' for this operation was the LZ 112 (L 70), the first 'x' type which had reached an altitude of some 7,000m during tests, whilst the other four ships, LZ 100 (L 53), LZ 103 (L 56), LZ 110 (L 63) and LZ 111 (L 65), had 6,000m ceilings. However, the defenders now deployed the two-seater DeHaviland DH-4 aeroplane, which had a ceiling greater than 6,000m. In any event, and for unknown reasons, three of the airships, L 53, L 65 and L 70, chose to approach the British coast at heights of some 5,000m, where they were intercepted by three of the aeroplanes. The report of one pilot, Maj. E. Cadbury, graphically describes what happened: 'The [explosive bullets were] seen to blow a great hole in the fabric and a fire started which quickly ran along the entire length of the Zeppelin. The Zeppelin raised her bows as if in an



The hangars at Ahlhorn were destroyed, together with LZ 87 (LZ 117), in January 1918 by an explosion. The cause was, and remains, unknown, but sabotage was suspected given the efforts made by the British to attack these bases. (Courtesy of the Zeppelin Museum, Tønder)

A: Pre-war Zeppelins 1900-14



B: Great War Zeppelins 1914-18



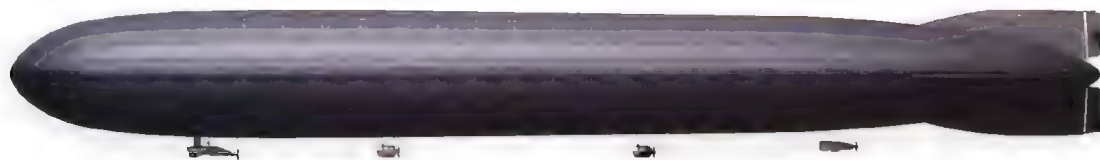
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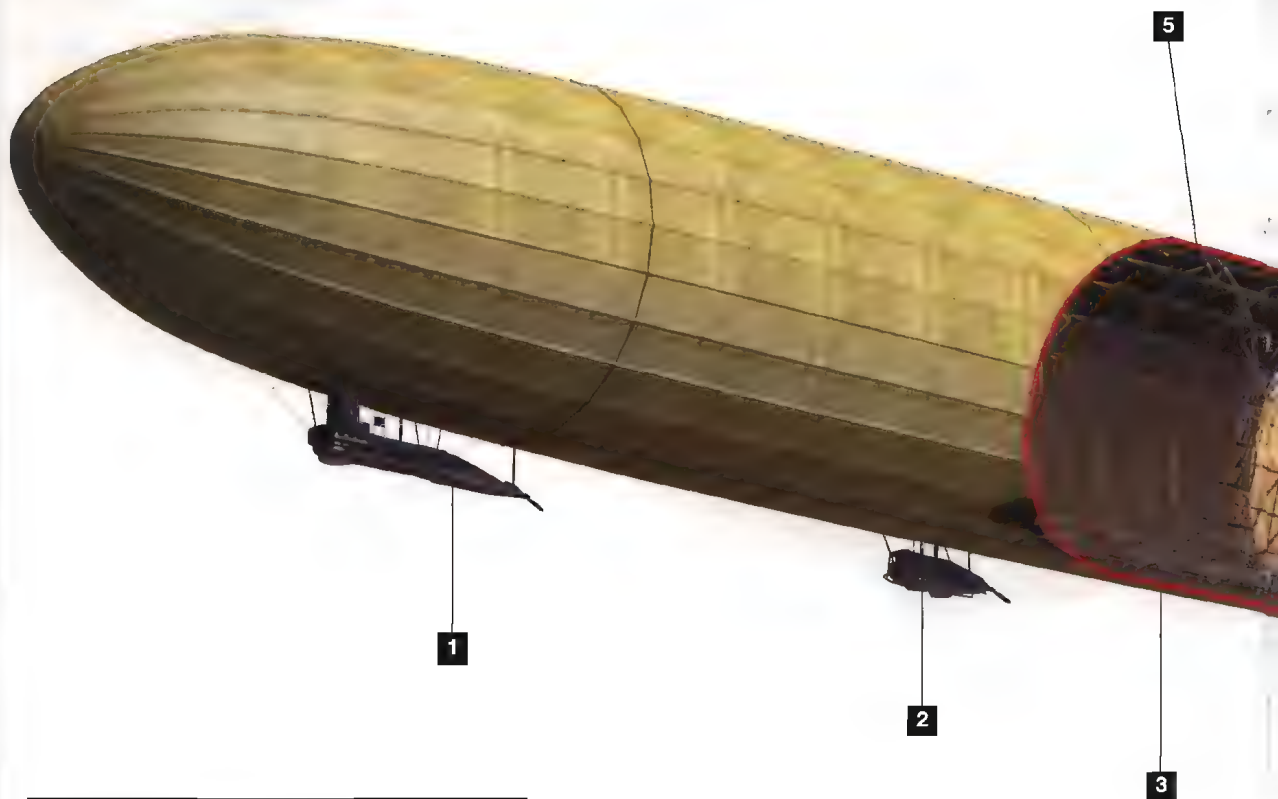


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C: Inter-war Zeppelins 1918-40

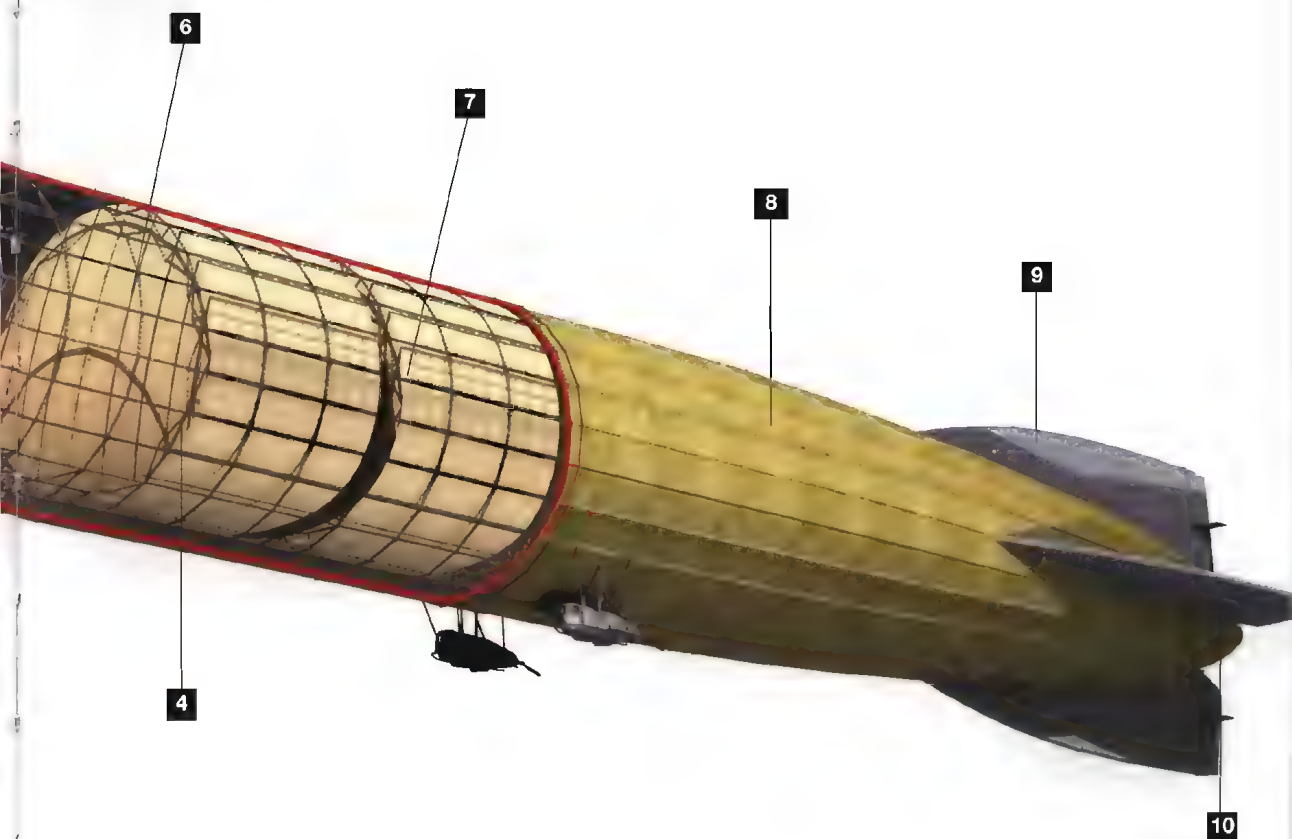


D: **AFRIKASCHIFF LZ 104 (L 59)**



KEY

- 1 Combined control/engine gondola with access into hull. The airship 'bridge' and forward 240hp engine
- 2 Engine gondola – 1 of 4, each containing a 240hp engine
- 3 Internal 'inverted V' Keel
- 4 Gas cell – two extra fitted making a total of 16
- 5 Structural ring/frame manufactured from Duralumin
- 6 Wire bracing – strengthening the rings and locating the gas cells in position
- 7 Longitudinal girders manufactured from Duralumin
- 8 Hull covering - the outer covering of the hull. Manufactured of undoped cotton
- 9 Vertical control surfaces – fixed, with rudder, above and below
- 10 Horizontal control surfaces – fixed, with elevator port and starboard



E: Airship and Spähkorb

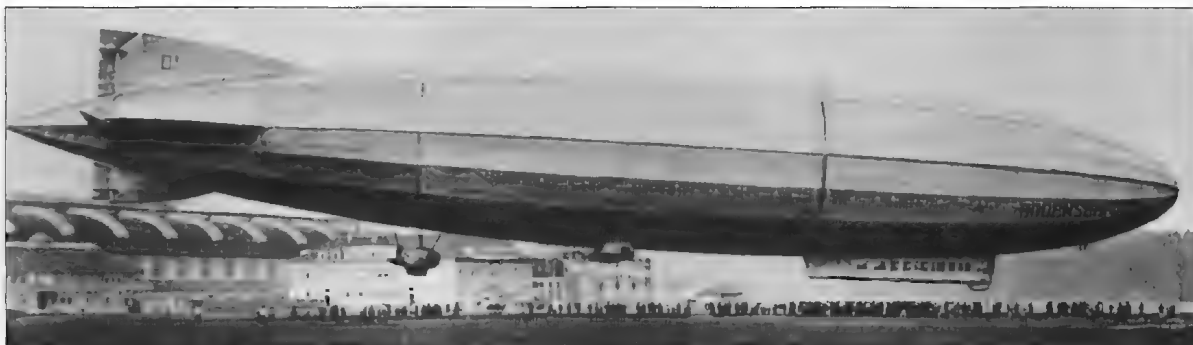




**F: The destruction of
SL 11 (SL XI)**



G: A defensive experiment



The first post-war airship, LZ 120 *Bodensee*, was constructed for DELAG and used for civil purposes, making over 100 flights and carrying some 2,300 passengers over 50,000km. The ship was seized and sent to Italy as reparations, where it was renamed *Esperia*, damaged, and eventually scrapped in 1921. (Courtesy of the Zeppelin Museum, Tønder)

LZ 114 was handed to the French in 1920 and renamed *Dixmunde*. It disappeared while over the Mediterranean in 1923. From remains found later, it seemed that there had been a massive mid-flight explosion, although the cause was unknown. (Courtesy of the Zeppelin Museum, Tønder)



effort to escape, then plunged seaward, a blazing mass. The airship was completely consumed in about $\frac{3}{4}$ of a minute.'

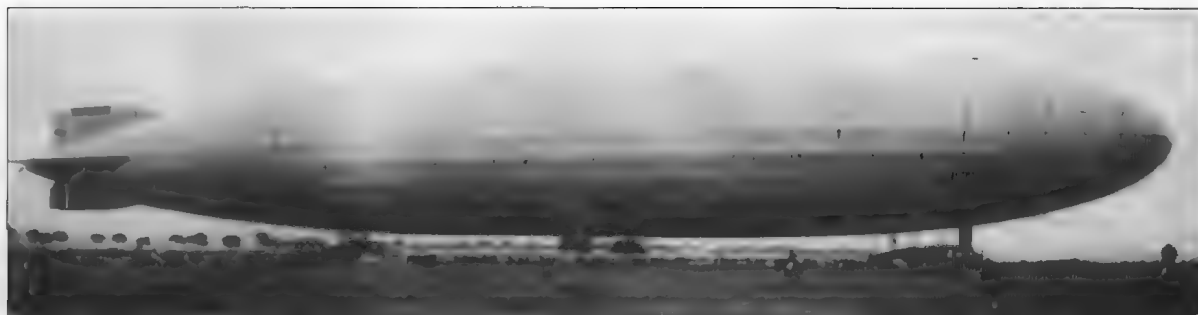
The downed airship was L 70, and there were no survivors. Strasser had perished in Imperial Germany's newest airship on what was to be the last strategic raid of the war. L 70 was not the last airship to fall victim to British fighters, however. On 11 August, while carrying out reconnaissance work over the North Sea, LZ 100 (L 53) was successfully intercepted by a Sopwith Camel launched from a lighter towed behind a destroyer. Despite operating at near maximum altitude, it taking the aeroplane an hour to climb anywhere near it, the airship was ignited by gunfire from some 100 metres below, and plunged into the sea.

The airship as a weapon of war had clearly been neutralised, and in any event the defeat of German arms of all kinds was acknowledged within three months by the signing of the Armistice.

REPARATIONS, COLLABORATION AND DISASTER: THE END OF THE RIGID AIRSHIP 1919-40

The Zeppelin Company was to survive the demise of its founder and the defeat of Germany, and continued to build airships under the leadership of the count's collaborator Dr Eckener. This achievement was partly due to the reactivation of DELAG in August 1919 with one ship, LZ 120 *Bodensee*. It was also, ironically, partly thanks to the reparations programme imposed on Germany by the Allies. For example, LZ 114 was completed the following year, but she was handed to France, as *Dixmunde*, a fate that also befell LZ 120, which went to Italy in 1921 and was renamed *Esperia*. A further proposed DELAG ship, LZ 121 *Nordstern*, also went to France, as *Méditerranée*, before the airline could take possession.

The seizure of airships for reparations purposes was enlarged upon by the US Navy, which required that they be supplied with an airship under the auspices of the programme. They placed a contract for what was to become LZ 126, a ship 'built in Germany by German workers

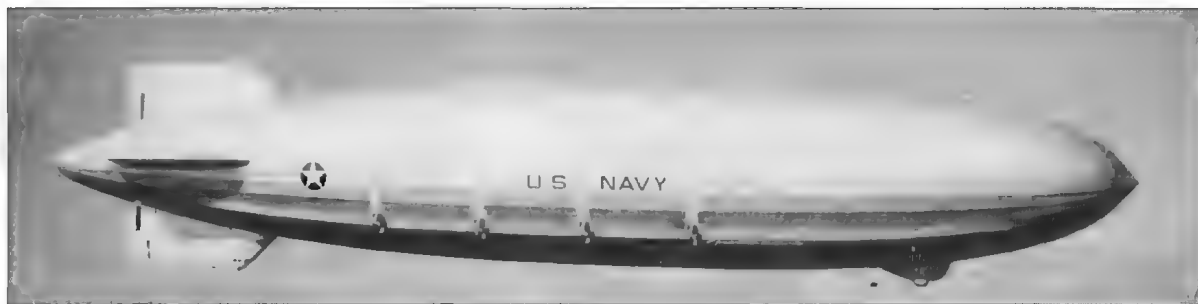


and engineers, paid for with German money, but which belongs to America', according to a disapproving piece in the *Berlin Morning Post*. The disapproval might have been natural, but such work kept the Zeppelin Company going, and the resulting ship was commissioned into the US Navy as *Los Angeles* after flying across the Atlantic, under the command of Dr Eckener, and arriving in the USA on 15 October 1924. Refilled with helium, a gas only available in the US, *Los Angeles* proved to be a most successful design, and is generally credited with being the ship that saved the Zeppelin Company. Even before it flew, the Goodyear Company had entered into a collaborative relationship with Zeppelin to manufacture airships for the US Navy, testimony to the respect felt for the airships. Goodyear-Zeppelin built two naval airships, ZRS 4 and ZRS 5, which first flew in 1931 and 1933 respectively as *Akron* and *Macon*. Of advanced design and utilising the vast experience of the Zeppelin Company, these helium-filled vessels proved that the technical concept, if not the tactical feasibility, of the flying aircraft carrier could be realised. Both were wrecked within two years of commissioning: *Akron* was forced into the sea by a storm, and *Macon* suffered structural failure in the tail, also at sea.

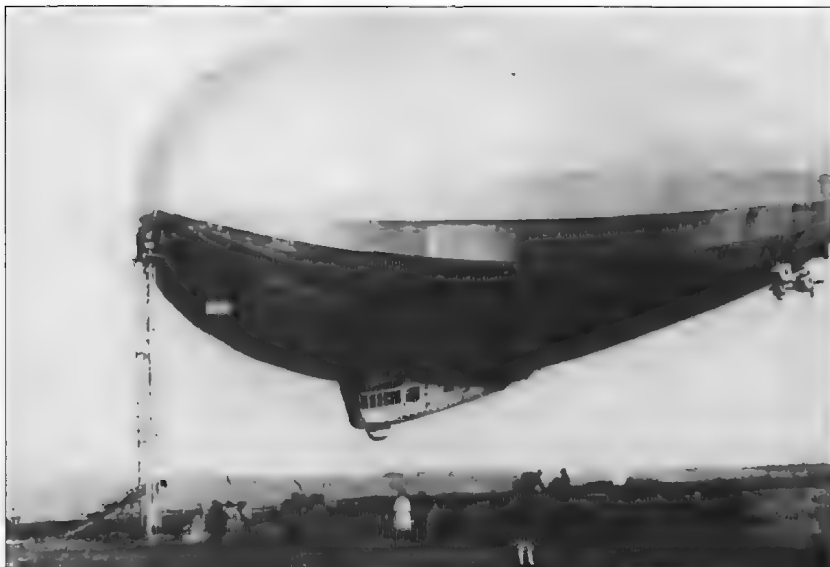
Meanwhile, L 127 had been built and flown in Germany and was named *Graf Zeppelin* in honour of the founder of the German airship. This vessel, again under Eckener's command, set an astonishing record in terms of the number and distance of flights it made: 590 in all, covering nearly 1,700,000km. It was the first airship to circumnavigate the globe, in a voyage lasting from 7 to 29 August 1929, with more than 12 days actually spent in the air. Capitalising on the success of *Graf Zeppelin*, two more airships (and the last as it happened) were commissioned and built: LZ 129 and LZ 30. The *Hindenburg* and *Graf Zeppelin II* were the largest and most sophisticated airships ever constructed, the former first flying in 1936, the latter in 1938.

Following active service over the Eastern Front, LZ 90 (LZ 120) was given to Italy in 1920 and renamed *Ausonia*. The vessel was decommissioned after suffering damage while in its hangar. (Courtesy of the Zeppelin Museum, Tønder)

The result of the collaborative relationship between Goodyear and Zeppelin, ZRS (S for Scouting) 4 *Akron* first flew in 1931. The engines were contained within the hull and the reversible propellers were able to swivel 90°, thus providing thrust through 360°. *Akron*, the first 'flying aircraft carrier', was wrecked within a year of commission, when a storm forced her into the sea in 1931. (Courtesy of the Zeppelin Museum, Tønder)

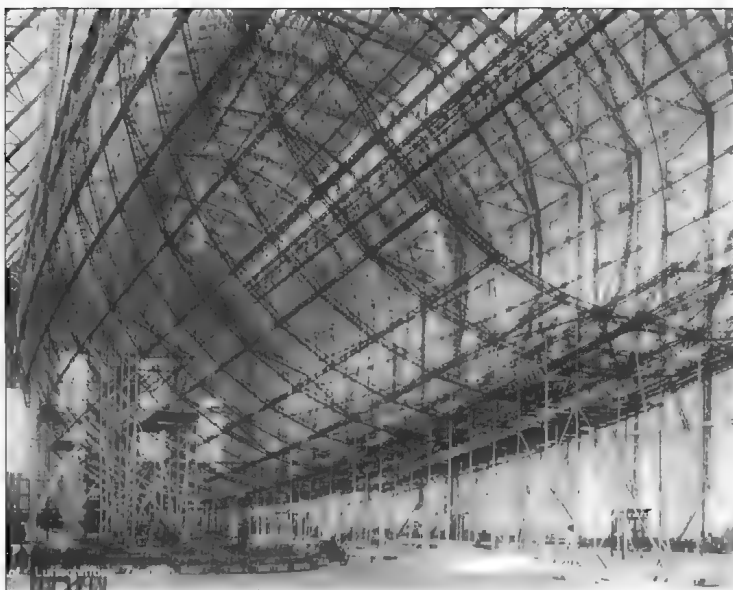


L 127 was named *Graf Zeppelin* in honour of the founder of the airship. This vessel set an astonishing record in terms of the number and distance of flights it made: 590 in all, covering nearly 1,700,000km. It was the first airship to circumnavigate the globe, in a voyage lasting from 7 to 29 August 1929, with more than 12 days spent in the air. (Courtesy of the Zeppelin Museum, Tønder)



Hindenburg (LZ 129) and her sister ship *Graf Zeppelin II* were the ultimate expression of the airship, being the largest and most sophisticated ever constructed. *Hindenburg* first flew in 1936 and was utilised mainly for transatlantic passenger service. (Courtesy of the Zeppelin Museum, Tønder)

This last date was, of course, the year after the spectacular filmed destruction of LZ 129 at Lakehurst, New Jersey, on 6 May 1937. The causes of the fire that consumed the airship within seconds, killing 37 people, remain speculative, but what is beyond question is that the incident signalled the death knell of the hydrogen-filled ship. The Germans forbade both the carrying of passengers, and any flights outside Reich territory in airships unless they were helium-filled. Helium could not be obtained, however, so that the last German airship, LZ 130, *Graf Zeppelin II*, was only employed on government business. Part of this involved the electronic reconnaissance of British radar installations along the east coast of the UK, which took place during August 1939, just weeks away from the attack on Poland and the beginning of the Second World War, a conflict in which the rigid airship could have no place.



The two remaining airships, L 127 and LZ 130, both curiously enough named *Graf Zeppelin*, were destroyed in early 1940 along with the hangars and production facilities that had created them. They were to be the last of the Zeppelins; the 1916 prediction that the future belonged to aeroplanes, made by the man the airships had been named after, had come to pass.

CONCLUSION

The technical difficulties intrinsic to the design of rigid airships, the high flammability of hydrogen and the inherent structural delicacy, combined to make the craft funda-

mentally ill suited for war; they could really only survive by evading hostile action altogether. High altitude operations lessened the risk to the craft from enemy action, but equally, restricted navigation and bombing accuracy. That the airship was relatively inefficient even when compared to the somewhat primitive aeroplanes available during the Great War may be adduced from the table below. This details statistics – taken from British sources – relating to airship raids on Britain during the period 1915–1918, with comparable figures for aeroplanes in brackets.

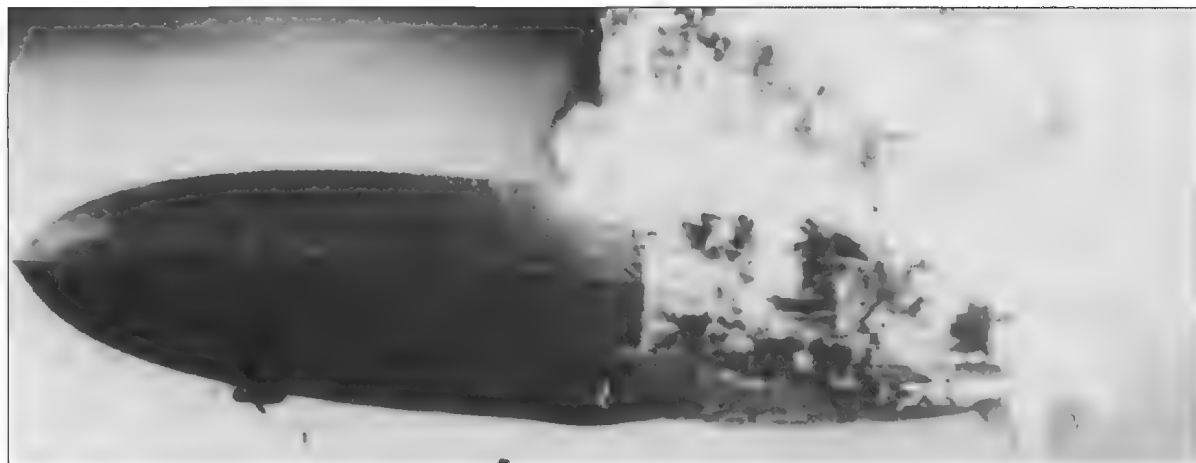
Year	Missions	Ordnance Delivered	Casualties: Killed	Casualties: Wounded
1915	42 (4)	1,526 (30)	184 (2)	447 (6)
1916	126 (28)	3,575 (201)	292 (10)	579 (47)
1917	30 (341)	620 (2,247)	38 (612)	72 (1,393)
1918	10 (59)	186 (387)	14 (164)	58 (395)
Totals	208 (432)	5,907 (2865)	528 (788)	1,156 (1,841)

Though the number of casualties caused per piece of ordnance delivered is a crude measurement, taking no account of material damage or the effect on morale, it nevertheless allows a comparison to be made between the relative efficiency of aeroplanes versus airships. On that basis, it can be seen that even though each airship sortie caused eight casualties, as compared to six per aeroplane sortie, an airship had to drop over three times as many pieces of ordnance as an aeroplane in order to wound or kill someone on the ground.

In a reconnaissance role the airship fared little better, and the US Navy was to find that replacing the lifting gas with non-flammable helium did nothing to render them less fragile. Both the Goodyear-Zeppelin ships were lost at sea during rough weather. The only conclusion available is that the airship was too inflexible and vulnerable to make a useful weapon.

In their civil role the German rigid airships were, ostensibly, highly successful, flying many tens of thousands of passenger miles safely. However, the reliability of the airship was dealt an irreparable blow in 1937 with the spectacular destruction of *Hindenburg*, an event witnessed, through the medium of the newsreel film, by a vast audience. This spelt the end for hydrogen-filled rigid airships, and as the US monopoly on

Whilst coming in to land at Lakehurst, New Jersey, on 6 May 1937, *Hindenburg* suffered a catastrophic hydrogen fire that started near the stern. Captured on film, the destruction of the vessel ended the airship age. (Courtesy of the Zeppelin Museum, Tønder)





Following the destruction of *Hindenburg*, her sister LZ 130 *Graf Zeppelin II* was prohibited from carrying passengers and from over-flying other states. Confined to Germany, her usefulness was minimal. This picture shows her along with the sheds at Frankfurt, which were demolished in 1940 together with the airship. *Graf Zeppelin II* was thus the last rigid airship to operate. (Courtesy of the Zeppelin Museum, Tønder)

helium was not broken until after the Second World War, for rigid airships in general. By 1945, aeroplane technology had advanced sufficiently to make the rigid airship obsolete. This is demonstrated by the following example; LZ 1 and LZ 130, the first and last of the kind, though constructed more than 35 years apart and of vastly different capacities, are obviously and fundamentally similar; the design and construction was basically incapable of evolving significantly. Contrasting this with the evolution of the design and construction of the aeroplane over roughly the same period, between the Wright brothers' 'Flier' and Mitchell's

'Spitfire' say, is surely proof that the rigid airship was, technologically, a blind-alley.

GLOSSARY

Airship: The generic term for any dirigible or powered lighter-than-air vehicle.

Ballast: A weight carried aboard a lighter-than-air vehicle to offset the buoyancy of its lifting gas. Usually water in a rigid airship.

Dirigible: A word that describes any steerable or directable airship.

Duralumin: An alloy of aluminium with copper, magnesium, manganese, iron and silicon. Stronger than aluminium, but nearly as light, it was adopted by the Zeppelin Company for constructing rigid airships.

Dynamic lift: The vertical movement of an airship created by aerodynamic forces acting on the shape of the vehicle.

Envelope: The gas-bag of a pressure or semi-rigid airship. Unlike a rigid airship gas cell, an envelope forms an external barrier to the elements, and when pressurized, serves an integral role in maintaining the airship's shape.

Gas cell: On a rigid airship, the impervious bag containing the lifting gas within the rigid framework and held in place by wire and cord netting.

Gondola: A term used to describe the external structures on an airship that house engines or control stations. The earliest airships had open-top, boat-shaped structures holding engines and crew.

Non-rigid airship: Another term for a pressure airship, whose shape is dependent on the gas inside its envelope having a higher pressure than the atmosphere outside.

Pressure height: The maximum altitude at which an airship can no longer contain its lifting gas due to its greater pressure compared to the surrounding atmosphere. At this altitude, automatic valves open to relieve the pressure or else the gas cell or envelope will burst.

Rigid airship: An airship whose shape is maintained by an internal framework, with the lifting gas contained in separate gas cells.

Schütte-Lanz: The rigid airship manufacturing company founded in Mannheim-Rheinau, Germany, by Johann Schütte and Karl Lanz.

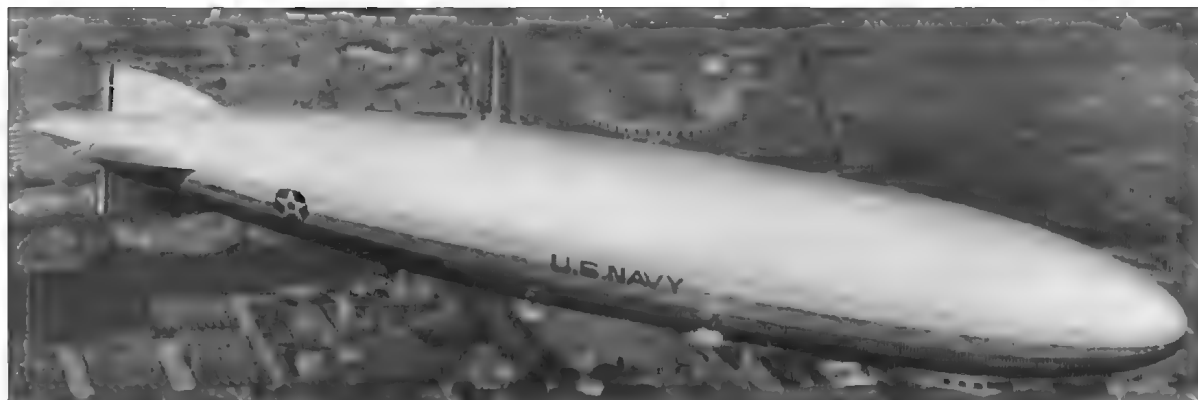
Semi-rigid airship: An airship with a rigid keel but whose envelope is maintained by gas pressure. The keel at the bottom of the envelope is used as a support for control car, engines, ballast and sometimes tail surfaces.

Static lift: The vertical force exerted on an airship created solely by the buoyancy of its lighter-than-air lifting gas.

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Completed in Germany for providing to the US by way of reparations, LZ 126 (US designation ZR 3: Z = Airship; R = Rigid; 3 = the third such unit) is credited by some with saving the Zeppelin Company from ruin following Germany's defeat in the Great War. LZ 126 was commissioned into the US Navy as *Los Angeles* ZR3 after flying across the Atlantic, under the command of Dr Eckener. After arrival on 15 October 1924, it was refilled with helium, a substance only present in relatively high concentrations in some natural gas fields, and at that time a US monopoly. Though helium had less lift than hydrogen, it was not explosive or flammable and *Los Angeles* was to prove a successful design. It was tested with a 'trapeze' device for launching and recovering aeroplanes, a measure taken to a further stage of development with the airships built by Goodyear-Zeppelin after those companies had entered into a collaborative relationship. LZ 126 (ZR 3) had five engine gondolas, configured in a 1:2:2 layout, with the control cabin integrated into the teardrop hull as first featured in the 'Y' types, LZ 120 and LZ 121. (Courtesy of the Zeppelin Museum, Tønder)



AIRSHIP DATA 1900-40

NB where no data has been recorded, this information was unavailable

0000 Type	First Flight	Makers N°	Army N°	Navy N°	Dimensions LgthxDia. (m)	Capacity m³	Engines (hp)	Speed km/h	Ceiling m	Range km	Payload tonnes	Year	Out of Service and Remarks
a	1900	L Z1			128x11.7	11,300	2x12	34	650	280	-	1901	Scrapped
b	1906	L Z2			128x11.7	11,300	2x85	40	850	1,100	2.8	1906	Wrecked by storm
b	1906	L Z3	Z I		128x11.65	12,200	2x85	40	850	1,100	2.9	-	-
		Rebuilt			-	-	2x100	-	-	-	-	1913	Scrapped
c	1908	L Z4			136x13	15,000	2x105	48	-	1,450	4.5	1908	Crashed
c	1909	L Z5	Z II		136x13	15,000	2x105	45	-	2,000	4.5	1910	Crashed
d	1909	L Z6			136x13	15,000	2x125	48	-	2,000	4.5	-	-
		Rebuilt			144x13	16,000	2x115	-	-	-	4.37	1910	Burned on ground
e	1906	L Z7	Deutschland		148x14	19,300	3x120	60	-	1,600	6.8	1910	Crashed
e	1911	L Z8	Deutschland (II)		148x14	19,300	3x120	60	-	1,000	-	1911	Wrecked on ground
A1	1911	SL 1			131x18.4	19,000	2x250	71	1,700	-	4.5	1913	Wrecked by storm
f	1911	LZ 9			132x14	16,500	3x125	78	-	1,600	4.6	-	-
		Rebuilt	Z II Ersatz		140x14	17,800	3x125	75	-	-	6.0	1914	Scrapped
f	1911	LZ 10	Schwaben		140x14	17,800	3x145	75	-	1,600	6.2	1912	Burned on ground
g	1912	LZ 11	Viktoria Louise		148x14	18,700	3x170	80	-	1,100	6.5	1915	Wrecked on ground
f	1912	LZ 12	Z III		140x14	17,800	3x170	75	-	1,600	6.2	1914	Scrapped
g	1912	LZ 13	Hansa		148x14	18,700	3x170	80	-	1,100	6.5	1914	Scrapped
h	1912	LZ 14	L 1		158x14.9	22,470	3x165	75	-	2,800	9.5	1913	Downed by storm
h	1913	LZ 15	Z I Ersatz		142x14.9	19,500	3x170	78	-	2,700	7.2	1913	Crashed
h	1913	LZ 16	Z IV		142x14.9	19,500	3x170	78	-	2,700	7.2	1916	Scrapped
h	1913	LZ 17	Sachsen		140x14.9	19,500	3x170	75	-	2,700	7.0	-	-
		Rebuilt			148x14.9	20,900	-	-	-	2,800	7.4	1916	Scrapped
i	1913	LZ 18	L2		158x16.6	27,000	4x180	75	-	2,100	11.1	1913	Burned on ground
h	1913	LZ 19	Z I Ersatz (II)		140x14.9	19,500	3x165	74	-	2,700	7.0	1914	Downed by storm
h	1913	LZ 20	Z V		140x14.9	19,500	3x170	74	-	2,700	7.0	1914	Shot down by AAA
k	1913	LZ 21	Z VI		140x14.9	20,900	3x170	75	-	1,900	7.8	1914	Damaged by AAA
B1	1914	SL 2	SL II		144x18.2	25,000	4x180	88	2,000	2,100	8.0	-	-
		Rebuilt			156x18.2	27,500	4x210	90	-	-	10.4	1916	Abandoned
l	1914	LZ 22	Z VII		156x14.9	22,100	3x180	72	-	2,000	8.8	1914	Shot down by AAA
l	1914	LZ 23	Z VIII		156x14.9	22,100	3x180	72	-	2,000	8.8	1914	Shot down by AAA
m	1914	LZ 24		L 3	158x14.9	22,500	3x220	80	2,500	2,200	9.2	1915	Crashed

m2	1914	LZ 25	Z IX	158x14.9	22,500	3x220	80	2,500	2,200	9.2	1914	Bombed in hangar
n	1914	LZ 26	Z XII	161.2x16	25,000	3x210	81	-	3,300	11.2	1917	Scrapped after war
m2	1914	LZ 27	L 4	158x14.9	22,500	3x210	81	2,500	2,200	9.0	1915	Crashed
m2	1914	LZ 28	L 5	158x14.9	22,500	3x210	81	2,500	2,500	9.5	1915	Shot down by AAA
m2	1914	LZ 29	Z X	158x14.9	22,500	3x210	81	2,500	2,200	9.0	1915	Shot down by AAA
m2	1914	LZ 30	Z XI	158x14.9	22,470	3x210	81	2,500	2,200	9.0	1915	Burned on ground
m2	1914	LZ 31	L 6	158x14.9	22,500	3x210	80	2,500	2,200	9.2	1916	Burned on ground
m2	1914	LZ 32	L 7	158x14.9	22,500	3x210	80	2,500	2,200	9.2	1916	Damaged by AAA, Scrapped
m2	1914	LZ 33	L 8	158x14.9	22,500	3x210	80	2,500	2,200	9.2	1915	Damaged by AAA, Scrapped
m2	1915	LZ 34	LZ 34	158x14.9	22,470	3x210	80	2,500	2,200	9.2	1915	Damaged by AAA, Burned
m2	1915	LZ 35	LZ 35	158x14.9	25,000	3x210	80	2,500	2,200	9.2	1915	Wrecked by storm
o	1915	LZ 36	L 9	161.4x16	24,900	3x210	85	3,000	2,800	11.1	1916	Burned on ground
m2	1915	LZ 37	LZ 37	158x14.9	22,500	3x210	80	2,500	2,200	9.0	1915	Bombed in air
p	1915	LZ 38	LZ 38	163.5x18.7	31,900	3x210	90	3,200	4,300	15	1915	Bombed in hangar
C1	1915	SL 3	SL 3	153.1x19.75	32,390	4x210	85	-	-	13.2	1916	Abandoned
C2	1915	SL 4	SL 4	153.1x19.75	32,470	4x210	85	-	-	13.4	1915	Destroyer in hangar
C3	1915	SL 5	SL V	153.1x19.75	32,470	4x210	83	-	-	14.3	1915	Abandoned
o	1915	LZ 39	LZ 39	161.4x16	25,000	3x210	85	3,200	2,800	10.0	1915	Shot down by AAA
p	1915	LZ 40	L 10	163.5x18.7	31,900	4x210	96	3,200	4,300	16.2	1915	Burned in air-lightning
p	1915	LZ 41	L 11	163.5x18.7	31,900	4x210	96	3,200	4,300	16.2	1917	Scrapped
p	1915	LZ 42	LZ 72	163.5x18.7	31,900	4x210	96	3,200	4,300	16.2	1917	Scrapped
p	1915	LZ 43	L 12	163.5x18.7	31,900	4x210	96	3,200	4,300	16.2	1915	Shot down by AAA
p	1915	LZ 44	LZ 74	163.5x18.7	31,900	4x210	96	3,200	4,300	16.2	1915	Crashed
p	1915	LZ 45	L 13	163.5x18.7	31,900	4x210	96	3,200	4,300	16.2	1917	Scrapped
p	1915	LZ 46	L 14	163.5x18.7	31,900	4x210	96	3,200	4,300	16.2	1919	Scrapped
p	1915	LZ 47	LZ 77	163x18.7	31,900	4x215	96	3,200	4,300	16.2	1916	Shot down by AAA
p	1915	LZ 48	L 15	163.5x18.7	31,900	4x240	100	3,200	4,300	16.2	1916	Crashed
p	1915	LZ 49	LZ 79	163x18.7	31,900	4x240	97	3,200	4,300	16.2	1916	Shot down by AAA
p	1915	LZ 50	L 16	163.5x18.7	31,900	4x240	97	3,200	4,300	16.2	1917	Crashed on landing
p	1915	LZ 51	LZ 81	163x18.7	-	-	-	-	-	-	-	-
Rebuilt				178.5x18.7	35,800	4x240	96	3,200	4,900	17.9	1916	Crashed
p	1915	LZ 52	L 18	163.5x18.7	31,900	4x210	96	3,200	4,300	16.2	1915	Burned on ground
p	1915	LZ 53	L 17	163.5x18.7	31,900	4x210	96	3,200	4,300	16.2	1916	Burned on ground
p	1915	LZ 54	L 19	163.5x18.7	31,900	4x210	96	3,200	4,300	16.2	1916	Shot down by AAA
p	1915	LZ 55	LZ 85	163.5x18.7	31,900	4x210	96	3,200	4,300	16.2	1916	Shot down by AAA

r	1916	LZ 74	L 32	198x23.9	55,200	6x240	103	4,000	7,400	32.5	1916	Shot down by aeroplane
r	1916	LZ 75	LZ 105	198x23.9	55,200	6x240	103	4,000	7,400	32.5	1917	Handed to Japan post war
r	1916	LZ 76	L33	198x23.9	55,200	6x240	103	4,000	7,400	32.5	1916	Shot down by AAA
q	1916	LZ 77	LZ 107	178.5x18.7	35,800	4x240	96	3,500	4,900	18.4	1917	Scrapped
r	1916	LZ 78	L 34	198x23.9	55,200	6x240	103	4,000	7,400	32.5	1916	Shot down by aeroplane
r	1917	LZ 79	L 41	198x23.9	55,200	6x240	103	4,000	7,400	32.5	1919	Scrapped
r	1916	LZ 80	L 35	198x23.9	55,200	6x240	103	4,000	7,400	32.5	1918	Scrapped
q	1916	LZ 81	LZ 111	178.5x18.7	35,800	4x240	96	3,500	4,900	18.4	1917	Scrapped
r	1916	LZ 82	L 36	198x23.9	55,200	6x240	103	4,000	7,400	32.0	1917	Crashed
r	1917	LZ 83	LZ 113	198x23.9	55,200	6x240	103	4,000	7,400	32.5	1920	Handed to France post war
r	1916	LZ 84	L 38	198x23.9	55,200	6x240	103	4,000	7,400	32.5	1916	Crashed
r	1917	LZ 85	L 45	198x23.9	55,200	6x240	103	4,000	7,400	32.5	1917	Destroyed by crew in France
r	1916	LZ 86	L 39	198x23.9	55,200	6x240	103	4,000	7,400	32.5	1917	Shot down by AAA
r	1917	LZ 87	LZ 117	198x23.9	55,200	6x240	103	4,000	7,400	32.5	1917	Burned on ground
r	1917	LZ 88	L 40	198x23.9	55,200	6x240	103	4,000	7,400	32.5	1917	Crashed on landing
r	1917	LZ 89	L 50	198x23.9	55,200	6x240	103	4,000	7,400	32.5	1917	Crashed
r	1917	LZ 90	LZ 120	198x23.9	55,200	6x240	103	4,000	7,400	32.5	1920	Handed to Italy post war
s	1917	LZ 91	L 42	196.5x23.9	55,500	5x240	103	5,500	10,400	36.4	1919	Scrapped
s	1917	LZ 92	L 43	196.5x23.9	55,500	5x240	103	5,500	10,400	36.4	1917	Shot down by aeroplane
t	1917	LZ 93	L 44	196.5x23.9	55,800	5x240	104	5,500	11,500	37.8	1917	Shot down by AAA
t	1917	LZ 94	L 46	196.5x23.9	55,800	5x240	104	5,500	11,500	37.8	1918	Burned on ground
u	1917	LZ 95	L 48	196.5x23.9	56,000	5x240	106	5,500	12,200	39.0	1917	Shot down by aeroplane
u	1917	LZ 96	L 49	196.5x23.9	56,000	5x240	103	5,500	12,200	39.0	1917	Captured - forced landing
u	1917	LZ 97	L 51	196.5x23.9	56,000	5x240	106	6,800	12,200	39.0	1918	Burned on ground
u	1917	LZ 98	L 52	196.5x23.9	56,000	5x240	103	5,500	12,200	39.0	1919	Scrapped
E9	1917	SL 16	SL XVI	174x20.1	38,800	4x240	95	-	-	21.5	1917	Scrapped
E10	1917	SL 17	SL XVII	174x20.1	38,780	4x240	95	-	-	21.5	1917	Scrapped
E11		SL 18	SL XVIII	174x20.1	38,800	4x240	95	-	-	21.5	-	Destroyed before 1st flight
E12		SL 19	SL XIX	174x20.1	38,800	4x240	95	-	-	21.5	-	Not built
F1	1917	SL 20	SL 20	198.3x22.96	56,000	5x240	102	-	-	35.5	1918	Burnt in hangar by crew
F2	1917	SL 21	SL XXI	198.3x22.96	56,350	5x240	102	-	-	35.5	1918	Scrapped
u	1917	LZ 99	L 54	196.5x23.9	56,000	5x240	103	5,500	12,200	39.0	1918	Bombed on ground
v	1917	LZ 100	L 53	196.5x23.9	56,000	5x240	115	6,500	13,500	40.0	1918	Shot down by aeroplane
v	1917	LZ 101	L 55	196.5x23.9	56,000	5x240	115	6,500	13,500	40.0	1917	Crashed
w	1917	LZ 102	L 57	211x23.9	62,200	5x240	131	7,000	12,000	43.5	-	1st Afrikaaschiff

[illegible]

COLOUR PLATE COMMENTARY



A: PRE-WAR ZEPPELINS 1900–14

A1: LZ 1: The first Zeppelin

LZ 1 is depicted on its maiden flight with the original method adopted for controlling pitch – a 150kg weight attached to the bow end of the open keel that could be winched towards, or lowered away from, the rear gondola. This was exchanged for the second flight with a weighted carriage that ran along the keel. Note the two small steering rudders above and below the tail, and the rudder towards the bow (one on each side). The 'outrigged' propellers were mounted away from the engines up on each side of the hull. Though the vessel only made three flights, in basic construction LZ 1 was essentially similar to all succeeding Zeppelin designs.

A2: LZ 13 *Hansa*

One of the craft manufactured for DELAG, *Hansa* entered service on 30 July 1913. Upon the outbreak of the Great War in August 1914, the vessel, along with *Sachsen*, was requisitioned for service with the *Heeresluftschiffe*. In this capacity it was used for training until 1916, when it was declared obsolete and the vessel was scrapped.

A3: LZ 14 (L 1)

Ordered in April 1912, LZ 14 was commissioned into naval service as L 1, and five other ships of the 'h' type were built during 1913. It was this vessel that was indirectly responsible for Korvettenkapitän Strasser's elevation, for when she foundered on 9 September 1913 one of those to perish was Korvettenkapitän Metzinger, the then Leader of Airships. Note the defensive position towards the bow, a platform with simple railings upon which a tripod-mounted machine gun could be fixed.

A4: LZ 24 (L 3)

The first of the 'm' type, commissioned in 1914, L 3 shares a unique place in aviation history with LZ 27 (L 4), in that these vessels initiated the first strategic air campaign, with L 3 bombing Great Yarmouth. Note the cruciform tail configuration, which was introduced even though the airship retained multiple elevators and rudders, as well as the defensive position close to the bow.

The wreckage of LZ 8 *Deutschland II*. The replacement for L 27 fared worse than her predecessor. As this photograph graphically demonstrates, the airship was wrecked after colliding with its own hangar shortly after going into service. (Courtesy of the Zeppelin Museum, Tønder)

B: GREAT WAR ZEPPELINS 1914–18

B1: LZ 47 (LZ 77)

A 'p' type Army airship, the matt black finish was for night-time camouflage purposes, though this was rendered largely ineffective during moonlit nights. Indeed, the airship was downed by French ground-fire while involved in operations over Verdun on the night of 20 February 1916. The altered texture of the upper covering around the top-middle portion of the hull was to allow any accumulation of hydrogen to escape.

B2: LZ 62 (L 30)

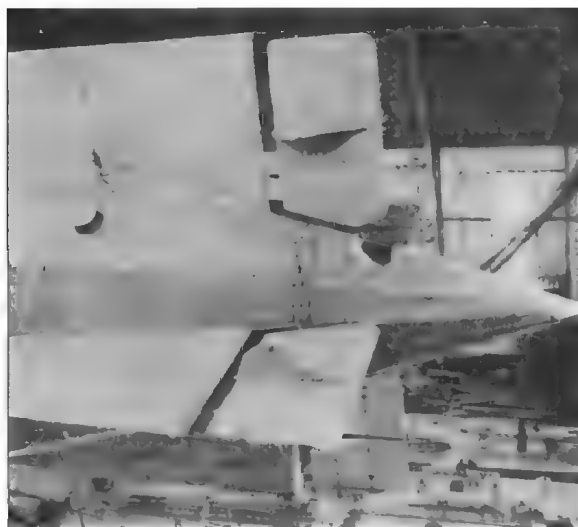
The first of the 'Super Zeppelins', this 'r' class airship first took to the skies at the end of May 1916. Sixteen of these vessels were to be completed before the end of the war, and they were to form a mainstay of the strategic offensive. Note the four-gondola/six-propeller arrangement, with each of the gondolas having a pusher propeller and a further two mounted on the hull.

B3: SL 3 (SL 3)

With the completion of SL 3 in February 1914, the Schütte-Lanz Company had constructed the largest airship in the world at that time. SL 3 entered naval service despite the disapproval of the Leader of Airships, who believed that the wooden plywood construction was inherently unsuitable for maritime use because it absorbed moisture and thus became unglued. His opinion was reinforced by SL 3's constant structural problems during her service in the Baltic. After suffering a heavy landing in a storm in 1915, the airship was abandoned the following year because of structural degradation. The shell-like detail towards the bow marks the securing point for anchor ropes.



LEFT Before the manufacture of LZ 18, external V-section keels had been a prominent visual feature of Zeppelin airships. Schütte-Lanz pioneered an internal keel in 1911, however, and the Zeppelin Company followed suit. This allowed the engine gondolas to be mounted closer to the hull. (Courtesy of the Zeppelin Museum, Tønder)



SL 8 completed more sorties than any other Schütte-Lanz airship, some 37 in all over her 18-month service life over the Baltic and the Eastern Front. The tail-gun arrangement shown here was experimental and not widely adopted; aeroplanes tended to approach airships from below. (Courtesy of the Zeppelin Museum, Tønder)

B4: LZ 112 (L 70)

The first 'x' type airship, an improved 'Height-Climber', was used by Strasser as his flagship during what turned out to be the last strategic raid of the war on the night of 5–6 August 1918. Note the difference between the matt-black underside, for camouflage purposes, and the lighter-coloured top. The ceiling of some 7,000m obviated the need for defensive armament on top of the hull, although the airship was destroyed by a DeHavilland DH-4 while at an altitude of some 5,000m during the raid. The entire crew, including Strasser, was lost.

C: INTER-WAR ZEPPELINS 1918–40

C1: LZ 121 (*Nordstern/Méditerranée*)

Dr Eckener reactivated DELAG in August 1919, and constructed LZ 120, which was named *Bodensee*, for the airline. However, this ship was handed over to Italy in 1921, as part of the reparations programme, and was renamed *Esperia*. LZ 121 *Nordstern* was the second of these post-war 'y' type civil airships, small in size but the first to feature a new shape hull with the control car incorporated into it, rather than being suspended below it. The hull of all previous airships had been constructed of sections of the same diameter, though with tapered bows and sterns, whereas this type introduced the 'teardrop' configuration which was adopted thereafter. The vessel was seized by France before DELAG could take possession, and renamed *Méditerranée*. It was lost in 1927 due to an airborne explosion, cause unknown.

C2: LZ 126 (ZR 3)

Completed in Germany for the USA as part of the war reparations programme, LZ 126 is credited by some with saving the Zeppelin Company from ruin following Germany's defeat in 1918. LZ 126 (ZR 3) was commissioned into the US Navy as *Los Angeles* after flying across the Atlantic under the command of Dr Eckener. After arrival on 15 October 1924, it was refilled with helium, a gas only available in the USA. *Los Angeles* was to prove a successful design, and was tested with a 'trapeze' device for launching and recovering aeroplanes, a measure taken to a further stage of development with the airships built by Goodyear-Zeppelin after those companies had entered into a collaborative relationship. LZ 126 (ZR 3) had five engine gondolas, configured in a 1:2:2 layout, with the control cabin integrated into the 'teardrop' hull as first featured in the 'y' types, LZ 120 and LZ 121.

C3: LZ 127 *Graf Zeppelin*

LZ 127 was named in honour of the founder of the type on the 90th anniversary of his birth in 1928. The increase in size over previous designs is obvious, as is the 'teardrop' configuration, though this was not the calculated optimal length-diameter ratio – the airship's size was restricted by the size of the hangar. This was the first ship to incorporate an innovative invention designed to counter the gradual lightening effect of fuel consumption. Previously, as a flight progressed the weight of the airship decreased, necessitating venting of gas

in order to maintain control. LZ 127 replaced liquid fuel with a combustible gas named 'Blau Gas' after its inventor Dr Hermann Blau. This fuel, sometimes known as 'Blue Gas', was contained in cells within the hull, and was only slightly heavier than air. Upon consumption, the equivalent volume of gas was replaced by air, thus preventing the problem of the alteration in weight over the course of a voyage.

C4: LZ 130 *Graf Zeppelin II*

Sister ship of the ill-fated LZ 129 *Hindenburg*, *Graf Zeppelin II* was more or less identical, apart from the use of tractor propellers rather than pushers; they were mounted on the front of the engine gondolas, rather than at the rear. Prevented from carrying passengers after *Hindenburg* burned in 1937, LZ 130, *Graf Zeppelin II*, was the last German airship, and only survived until 1940 when, on the orders of Reichsmarshal Hermann Goering, she was broken up. Goering's motives for this act have been the subject of investigation, but in any event, she could have had little or no use during the Second World War.

D: AFRIKASCHIFF LZ 104 (L 59)

The only specific variant, the *Afrikaschiff*, was constructed for a one-way sortie to *Deutsch-Ostafrika* (German East Africa) in 1917. LZ 104 (L 59) was converted from a 'w' type airship into the longest airship built up to that time, a dimension not exceeded until 1924 by LZ 126. The length of 226m was achieved by inserting two extra gas cells (16 instead of 14) into the hull. These, it has been claimed, were to be converted for use as sleeping bags by the German forces in the colony. It seems unlikely that gas cells would have sufficed for such a use, because in the days before synthetic materials, gas cell fabric had to combine durability, impermeability and availability, a tricky requirement in wartime. This was found in a material named 'goldbeaters skin', which was formed from the bladders of cattle. Three layers of goldbeaters skin were found to give the best results, and this was used until replaced with treated silk.

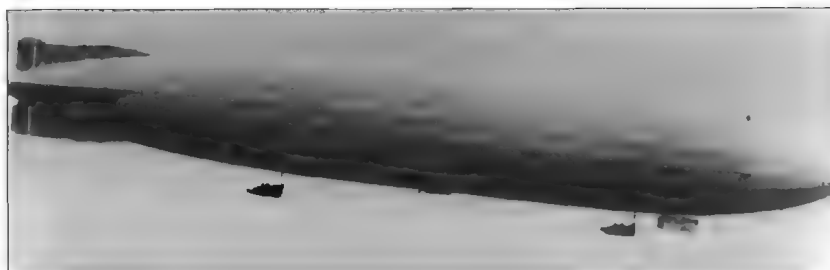
Apart from the addition of extra gas cells, the *Afrikaschiff* was otherwise of conventional construction, and the position of these cells within the hull can be readily ascertained in this drawing. Note also the triangular section internal keel along the bottom of the hull. In the early airships this had been inverted so that it protruded below the hull, such a configuration being known as an external keel.

Although the mission to East Africa was ultimately unsuccessful, the *Afrikaschiff* demonstrated the feasibility of intercontinental flight. The airship proved somewhat ineffective as a long-range bomber, however, the role allocated to it following the marathon flight. It was while on a lengthy mission to attack shipping in the Grand Harbour, Malta, that the *Afrikaschiff* suffered from a hydrogen fire and was lost in April 1918.

E: AIRSHIP AND SPÄHKORB

Following the downing of four Army airships in August 1914, the impossibility of daytime operation became obvious. The only possible exception was in conditions of thick cloud cover, although if the airships were invisible to ground observers, visibility from the aircraft was also very poor. Observation and bombing thus became impossible. In order to overcome this problem, a manned *Spähkorb*, or sub-cloud car, was adopted in Army airships. This was lowered on a 750m cable, and equipped with a telephone for communication purposes. Despite the obvious drawbacks of manning such a position (including intense cold and the potential danger from dropped munitions), it was nevertheless popular with the crew because it was the one place on the airship where smoking could be indulged in safely.

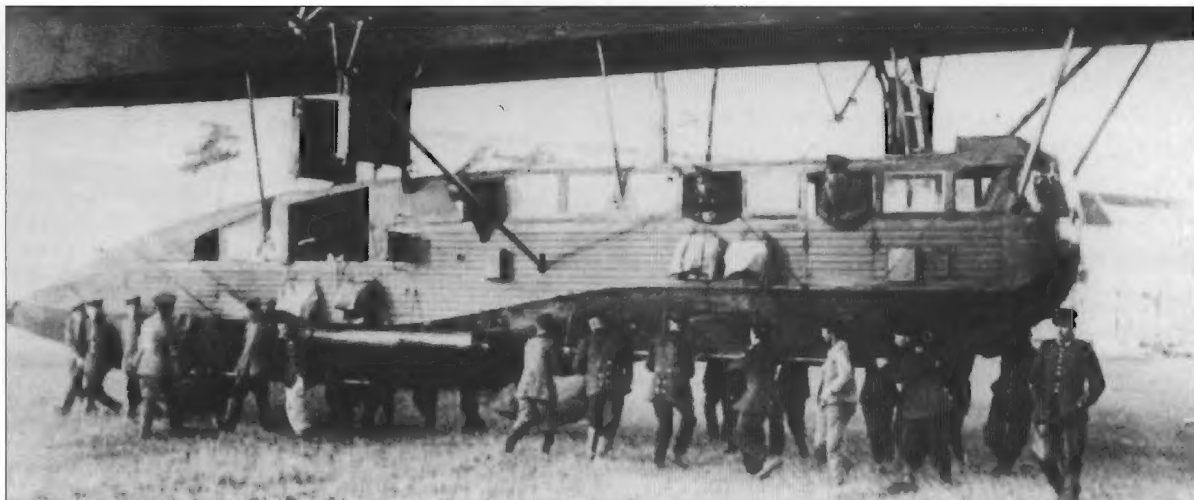
These cars were 'home made' by the crews, with first operational usage taking place in March 1916. The *Spähkorb* of LZ 60 (LZ 90), of a somewhat different design to the one shown, was lost over the UK in September 1916 when its winch apparently ran out of control. This device is displayed in the Imperial War Museum, London.



SL 9 was transferred to the Navy in 1917 after the Army gave up using airships. This ship was lost over the Baltic, probably after a lightning strike. (Courtesy of the Zeppelin Museum, Tønder)



Originally built for civil use, LZ 26 (Z XII) was the airship that first deployed the *Spähkorb*, or sub-cloud car, which was employed on a raid on Calais in 1916. Note the structure that would have been the passenger cabin. Decommissioned in 1917 when the Army gave up airships, she survived the war and was scrapped afterwards. (Courtesy of the Zeppelin Museum, Tønder)



F: THE DESTRUCTION OF SL 11 (SL XI)

The Army airship SL 11 (SL XI) became the first German airship lost to the British fighter defences on the night of 2 September 1916. In his report 2nd Lieutenant Leefe Robinson of the Royal Flying Corps, flying a BE2c fighter, noted '... I flew along about 800 feet below it from bow to stern and distributed one drum along it (alternate explosive and incendiary rounds New Brock and Pomeroy). It seemed to have no effect; I therefore moved to one side and gave it another drum distributed along its side – without apparent effect. I then got behind it (by this time I was very close – 500ft or less below) and concentrated one drum on one part (underneath rear). I was then at a height of 11,500 feet when attacking Zeppelin. I had hardly finished the drum before I saw the part fired at glow ... I quickly got out of the way of the falling blazing Zeppelin ...'

As the hydrogen burned, the lift at the stern decreased, tilting the ship's bow upwards. The flames then spread forwards whilst the hull covering burned away at the rear revealing details of the structure beneath, which in the case of SL XI, and all Schütte-Lanz airships, was of plywood.

The remains of SL 11 landed behind the Plough Inn at Cuffley, and the impressive mode of destruction shed a brilliant light for miles across London and the surrounding area. This very visible proof of the efficiency of the defences ensured that Leefe Robinson, who was awarded a Victoria Cross, became a hero to the British public.

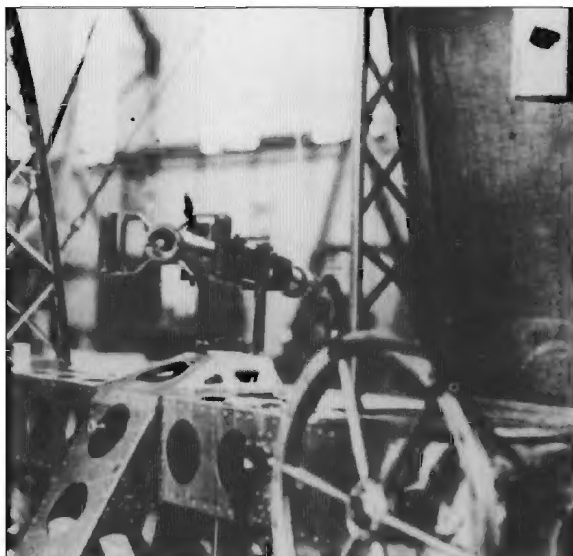
G: A DEFENSIVE EXPERIMENT

On 26 January 1918 the naval airship LZ 80 (L 35) took off with an Albatross D-III fighter suspended beneath it. The aeroplane pilot remained in his craft throughout the flight under the 'mother-ship', with the engine running; there would have been no safe way for him to transfer whilst airborne, and no way of manually starting the engine. This plane was released at a height of some 1,500m and flew safely away.

The rationale behind this endeavour was to investigate ways of providing some protection against enemy fighters, which had, since the advent of the Brock and Pomeroy type of ammunition, been fatal to Zeppelins – if they could climb high enough to make contact with them. The project was not followed up, but was a precursor of the later technique,

ABOVE A view of the command gondola, complete with integral engine, one of the four 240hp Maybach engines that powered the LZ 63 (LZ 93). (Courtesy of the Zeppelin Museum, Tønder)

BELOW Defensive armament was mounted on top of the hull, briefly tried in the tail, and also carried in the gondolas. This picture shows a gondola-mounted 20mm cannon. Despite this firepower, however, only one aeroplane is recorded as being bested by an airship during an airborne shoot-out. (Courtesy of the Zeppelin Museum, Tønder)



developed and perfected by the US Navy in the airships *Akron* and *Macon*, whereby up to five aircraft stored in an onboard hangar could be launched and recovered. The inherent fragility of the airship, combined with rapid advances in aeroplane technology, meant that whilst it was possible to construct and operate a flying aircraft-carrier, it would have been of little or no utility during hostilities.

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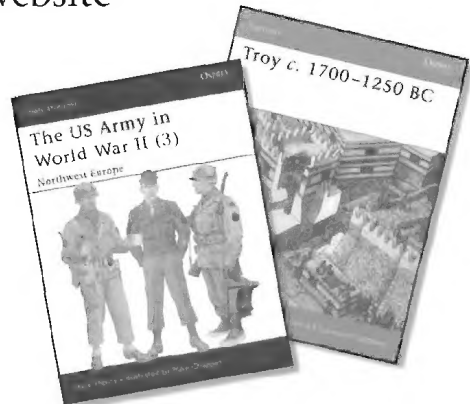
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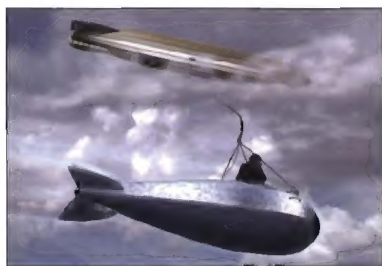
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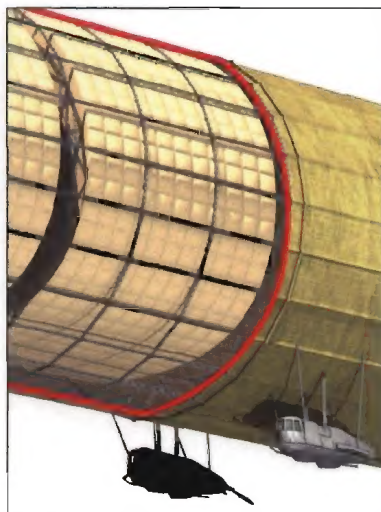
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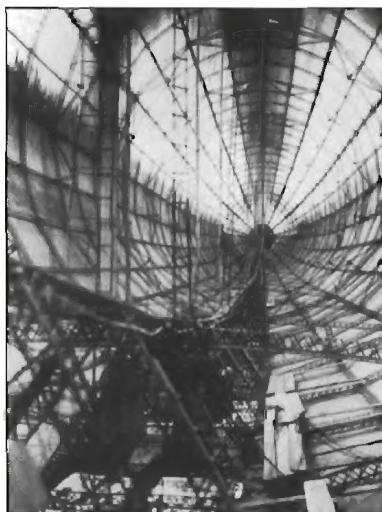
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